Experiencing Historical Processes

Museum learning practice and digital technologies

Marchetti, Emanuela

DOI (link to publication from Publisher):
10.5278/vbn.phd.hum.00048

Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

EXPERIENCING HISTORICAL PROCESSES

MUSEUM LEARNING PRACTICE AND DIGITAL TECHNOLOGIES

BY
EMANUELA MARCHETTI

DISSERTATION SUBMITTED 2016

AALBORG UNIVERSITY
DENMARK

Experiencing Historical Processes

Museum learning practice and digital technologies

By

Emanuela Marchetti

AALBORG UNIVERSITY

DENMARK

Dissertation submitted

Thesis submitted: June, 2016

PhD supervisor: Associate Professor Lars Birch Andreasen,
Aalborg University

PhD committee: Associate Professor Kathrin Otrel-Cass (chairman)
Aalborg University

Dr. Senior Lecturer Lieselotte van Leeuwen
University of Sunderland

Prof. with Special Responsibilities Ole Sejer Iversen
Aarhus University

PhD Series: Faculty of Humanities, Aalborg University

ISSN (online): 2246-123X
ISBN (online): 978-87-7112-383-8

Published by:
Aalborg University Press
Skjernvej 4A, 2nd floor
DK – 9220 Aalborg Ø
Phone: +45 99407140
aauf@forlag.aau.dk
forlag.aau.dk

Cover Photo: Jan Brødslev Olsen

Printed in Denmark by Rosendahls, 2016

CV

My name is Emanuela Marchetti and I was born in Vercelli, in the north of Italy in 1977.

I own a master degree in Ancient Literature and Archaeology from the University of Torino with a final grade of 110/110, 12 in the Danish scale. I wrote my master thesis on Viking Age settlement culture spending 1 year at the Aarhus University.

While in Denmark I took a second master in IT Product Design at the University of Southern Denmark in Sønderborg. I ended my studies with a 12 grade on my master thesis that was completed during a 1-year internship at Philips Research (Eindhoven, The Netherlands) and focused on the development of interactive board games.

During my PhD I worked for one year as a doctoral researcher at Warwick Business School (England), where I won the IKON and the ESRC scholarships.

Currently I am doing my PhD at Aalborg University and teaching design related subjects at Erhvervsakademi Lillebælt in Odense.

My research focuses on playful learning, design anthropology, and interaction design. I am especially interested in exploring how digital technologies could support and enrich learning practices in different contexts, such as museums and schools, through the development of playful digital installations and other applications. I see technologies as means to enrich social interaction during learning and also as resources for learners to grasp challenging concepts.

English Summary

This thesis discusses a study about the role of digital technologies within museum learning practices targeted at young visitors. The thesis builds on studies of sociocultural activity (Rogoff 1995, 1990) and design-oriented research (Fallman 2003), in order to investigate how digital technologies could contribute to museum learning practices.

Through a literature review and my field study, I found that museum learning practice is going through a shift or multiple shifts in the role of museums within society (Janes 2009; Lang et al. 2006, Fleming 2005). One of these shifts is the digitisation of museums, which is expected to enrich the experience of young visitors, in particular for primary school children. However, the digitisation of museum learning practice is not taking place as an effortless phenomenon, as discussed in the first and fifth included papers, as issues have emerged in relation to external pressures on museums. Current studies position themselves on two parallel discourses: a macro level discourse mainly represented by museum studies, which focuses on the role of museums within society; and a micro level discourse mainly represented by interaction design studies about museums, which focuses on discussing the experience of individual visitors with digital exhibits.

It is argued in this thesis that micro and macro level discourses should be bridged in order to understand how digital technologies could contribute to the museum learning practice, from the different perspectives of museum practitioners and visitors. Therefore, a design-oriented participatory study has been conducted (Pink 2007; Druin 2002), involving 25 children around 9-10 years old and museum practitioners in the process of designing a new digital exhibit, called MicroCulture, aimed at enriching the learning of history inside the museum. MicroCulture is a tabletop, interactive simulation of urban development in the Viking Age, focusing specifically on the case of Ribe. The study was conducted in cooperation with two local historical museums (The Viking Museum in Ribe, Denmark, and The Transport Museum in Coventry, England). The study focused on guided tours as the main unit of analysis, considered here as a typical but little studied practice (Best 2012), addressed especially to primary school pupils.

This study provided two main kinds of contributions: a theoretical one in the form of an inclusive framework bridging micro and macro level discourses, which builds on Rogoff's studies of sociocultural activity (1990, 1995), and a practice-oriented one in the form of new insights on guided tours and on how digital exhibits could enrich guided tours. These two contributions were gained through the design of a technological solution (called MicroCulture) that leverages on mediated play and museums' existing practices, in order to show that digital exhibits can enrich museum learning practices, empowering children's interaction with the guides and the museums' learning practice.

A playful learning scenario is proposed, discussed in the second and fourth paper, which builds on the framework of apprenticeship in thinking" (Rogoff 1990) and mediated play as a resource for conceptual thinking and learning (Vygotsky 1978; Wertsch 1991). Moreover, as discussed in the third paper presented in this thesis, the design process also takes into account children's individual needs, regarding play and museum experience. Evaluations with MicroCulture (fourth paper) show that mediated play allows turning guided tours from a lecture into a dialogue, as pointed out also by Rogoff (Rogoff 1990). The experience gained with MicroCulture also shows that technologies can enrich daily innovation practices. As suggested in the fifth and last paper in this thesis, technologies can be made into a flexible tool to enable museum practitioners to experiment new settings reusing the same hardware. In this way, the use of an exhibit like MicroCulture, composed of off-the-shelf technologies could contribute to emergent practices such as "innovation enclosures",

which I define as the practice of conducting explorations through the creation of temporary, thematic exhibitions.

Danish Summary

Nærværende afhandling diskuterer et studie af digitale teknologiers rolle i museers læringspraksis, som er målrettet de helt unge museumsgæster. Afhandlingen bygger på sociokulturelle aktivitetsstudier (Rogoff 1995, 1990) og design-orienteret forskning (Fallman 2003) til at undersøge, hvordan digital teknologi kan bidrage til museernes læringspraksis.

Gennem et litteraturstudium og mit feltstudium fandt jeg frem til, at museers læringspraksis er under forandring i takt med ændringer i museers rolle i samfundet (Janes 2009; Lang et al. 2006, Fleming 2005). En af disse forandringer er den øgede digitalisering af museerne, som forventes at berige de yngre gæsters oplevelse. Dette gælder især for børn i grundskolen. Digitalisering er ikke nogen nem øvelse, som det også fremgår af dem første og den femte artikel i afhandlingen, eftersom museerne også oplever pres udefra. De eksisterende studier positionerer sig i forhold til to parallelle diskurser. Dels i forhold til et makroniveau hvor især museumsstudier fokuserer på museernes rolle i samfundet. Dels i forhold til et mikroniveau, der især handler om interaktionsdesignstudier, som fokuserer på den enkelte gæsts oplevelse af de digitale udstillinger.

I nærværende afhandling argumenteres der for at slå bro imellem de to diskursniveauer for at forstå, hvordan de digitale teknologier kan bidrage til museernes læringspraksis set fra både de professionelle museumsmedarbejderes og gæsternes perspektiver. Der er derfor blevet udført et design-orienteret participatorisk studium (Pink 2007; Druin 2002) med 25 børn mellem 9 og 10 år samt professionelle museumsmedarbejdere, mens en ny digital udstilling, kaldet MicroCulture, blev designet, som havde til formål at berige historielæringen på museet. MicroCulture er en MicroCulture er en interaktiv, berøringsfølsom installation i bordhøjde, som er en simulation af byudviklingen i vikingetiden specielt med fokus på Ribe. Det design-orienteret studium blev udført i samarbejde med to lokale museer (Vikingemuseet i Ribe, Danmark, og The Transport Museum i Coventry, England). Studiet fokuserer på guidede ture som den væsentligste analyseenhed. Guidede ture som typisk praksis er nemlig ikke meget undersøgt (Best 2012) og er specielt henvendt til grundskoleelever.

Denne studium har bidraget med to typer væsentlige aspekter. For det første type teoretiske resultater i form af en inkluderende rammesætning, der slår bro imellem mikro- og makrodiskurserne, og som bygger på Rogoff's studier af sociokulturel aktivitet (1990, 1995). For det andet type mere praksisorienteret resultater i form af nye indsigter om guidede ture og hvordan digitale udstillinger kan berige disse. Disse to bidrag er opnået igennem et design af en teknologisk løsning (MicroCulture), som udnytter medieret leg og museets eksisterende praksisser til at undersøge, hvordan digitale udstillinger kan berige museets læringspraksis ved at gøre det muligt for børnene at interagere med guiderne og museets læringspraksis.

Afhandlingens anden og fjerde artikel foreslår og diskuterer et legende læringsscenarie, som bygger på "apprenticeship in thinking" (Rogoff 1990) og medieret leg som en ressource til begrebsmæssig tænkning og læring (Vygotsky 1978; Wertsch 1991). Som den tredje artikel diskuterer, tager den participatoriske designprocess hensyn til børnenes individuelle behov, når det gælder leg og museumsoplevelse. De endelige evalueringer af MicroCulture (som det fremgår af den fjerde artikel) viser, at man med medieret leg kan ændre guidede ture fra foredrag til dialog, som også Rogoff pointerer (Rogoff 1990). Erfaringen med MicroCulture viser desuden, at teknologier kan berige hverdagens innovationspraksisser. Som foreslået i afhandlingens femte og sidste artikel kan teknologier blive fleksible redskaber, der sætter de professionelle

museumsmedarbejdere i stand til at eksperimentere med nye opsætninger med den samme materiel. Således kan brugen af en udstilling som MicroCulture, der består af allerede tilgængelige teknologier, bidrage til spirende praksisser, sådan som "innovation enclosures" sådan som jeg definerer det at udføre undersøgelser ved at skabe tidsbegrænsede, tematiske udstillinger.

Keywords

Apprenticeship in thinking, shift in the role of museums, guided participation guided tours, participatory design, digital exhibits.

Acknowledgements

I with to thank all the people, who have helped me in this difficult process, in particular:

I wish to thank my new supervisor Lars Birch Andreasen for having dedicated so much of his time to help me revise my text and for giving me valuable guidance.

Kathrin Otrel-Cass for being the chair of the committee

Antje Gimmler and Annette Lorentsen who have supported me in many ways.

The ICLearning group who have given me new interesting opportunities and have been good friends to me in these years.

The committee for their constructive and detailed feedback, which enabled me to take new directions with my thesis.

Special thanks to my family: my husband Andrea Valente for his valuable help in developing the software of MicroCulture, for all the good discussions we have had together, and for his patience throughout this process and my daughter Alexandra, the first tester of MicroCulture, who has been so patient in waiting for my writing to be done.

Table of Contents

Publications included in the thesis

This is an article-based PhD-thesis, building on five peer-reviewed research publications. The five publications consist of two full papers published in conference proceedings, two book chapters, and one journal article. These five publications–and the relations between them and the research questions of the thesis–are further presented and discussed in section 1.4.

1. On the edge between tradition and innovation. Reassembling museums as emerging creative organisations

Marchetti, Emanuela and Nandhakumar, Joe, (2011)

Full paper published in conference proceedings, peer-review.

27th EGOS Colloquium Program, EGOS Digital Library, European Group for International Studies Colloquium, Sage, July 6 – 9 2011, Gøteborg, Sweden.

The paper discusses the changes affecting museums based on results gathered from the field study conducted at two sites, the Viking Museum in Ribe, Denmark, and the Transport Museum in Coventry, England. The first author contributed with empirical work, theoretical perspective, and most of the writing. The second author contributed with reviews and suggestions of relevant literature and insights.

2. From lecturing to apprenticeship: introducing play in museum learning practice

Marchetti, Emanuela and Petersson Brooks, Eva, (2012a)

Full paper published in conference proceedings, peer-review.

Proceedings of eL&mL 2012: The Fourth International Conference on Mobile, Hybrid, and On-line Learning, eds. Valerdi, J., Krämer, B., and White, S., January 30 – February 4, Valencia, Spain, International Academy, Research, and Industry Association (IARIA), pp.94-99.

In this paper, a new scenario for museum learning practice is proposed, starting from Rogoff's (1990) theory of apprenticeship in thinking. In this new scenario, the guided tour is envisioned as a participatory apprenticeship, in which children and guides interact at the same level through play. Both authors contributed with writing and reflections, the first author provided empirical data and theoretical insights.

3. Playfulness and Openness: Reflections on the Design of Learning Technologies

Marchetti, Emanuela and Petersson Brooks, Eva, (2012b)

Book chapter, published, peer-review.

Arts and Technology. Lecture Notes of the Institute of Computer Sciences, Social Informatics and Communication Engineering (LNICST), ed. Brooks, A. L., Springer Publishing Company, 101, 2012, pp. 38 – 45.

In this paper, results from the participatory design process are discussed, focusing on the emergence of children's individual needs concerning their play and museum experience. Leveraging on playfulness and multimodality, a reflection is proposed related to the need of creating open and multimodal learning technologies in order to allow the learners to express themselves and gain ownership and control over their experience. Both authors contributed with

writing and critical insights, the first author provided also empirical data and the theoretical framework.

4. Playful learning culture in the museum. MicroCulture and Guided Tour Practice

Marchetti, Emanuela, (2013)

Book chapter, published, peer-review.

Teaching and Learning Culture. Negotiating the Context, eds. Kirkebaek, M. J., Du, X., and Jensen, A. A., October 11 2013, Sense Publisher, Rotterdam, The Netherlands, pp. 129-144.

This chapter discusses the results from the final evaluation of MicroCulture, reflecting on the on-going changes in museum learning practice, from the perspective of two competing traditions: the modernist and the postmodern. Digital technologies are investigated as introducing opportunity to shift towards the postmodern tradition, which values an open dialogue between the museum and the visitors. Digital technologies are seen as introducing a playful learning culture inside the museum, through the practice of guided tours, so to foster a constructive dialogue among the participants.

5. Diachronic perspective and interaction. New directions for innovation in historical museums

Marchetti, Emanuela and Valente, Andrea, (2013)

Article published in journal, peer-review.

The Technology Collection. International Journal of Technology, Knowledge and Society, 8 (6), 2012-2013, Common Ground Publisher, pp. 131-143.This paper represents an attempt to analyse museum innovation and the role of digital technology, from two emergent perspectives: a micro level perspective, dealing with what happens inside a specific museum, and a macro level perspective, dealing with the role of museums within society. The argument is based on the empirical data provided from the first author, who also contributed with writing and critical reflections regarding how different technologies would affect learning of history; the second author participated in a survey on available technology, conceptualisation of possible solutions, and writing.

A number of other publications have been completed during the PhD period. For a list of these other papers see the Aalborg University research portal:

http://vbn.aau.dk/en/persons/emanuela-marchetti%282aa7318c-a468-46eb-a33f-49198b1bc34a%29.html

Preface

The main concept of this thesis emerged from my personal experience: my education and research in medieval archaeology, my education in IT Product Design, and on a preliminary survey on museums I conducted during the formulation of my project proposal. My Ph.D. experience represents a reflection of my personal growth path through the different disciplines I have encountered.

During my first education in archaeology, which started in Torino and ended in Århus (2002-2003), I focused on settlement culture during the Viking and Middle Ages. At that time, I also participated in a project with some friends. Our aim was to create a simulated population and our reflections gave me a stimulating perspective to think of.

During my design education in Denmark, two projects were crucial in determining my present research direction, a three-week project cooperation with Taarnborg, a private museum in Ribe, and my master project as an interaction design researcher at Philips Research, Eindhoven, The Netherlands.

The first project gave me the opportunity to cooperate with a museum curator with the aim of designing "something" to enhance visitors' experience and learning. The target group was people around 60-70 years old with a passion for local history and religion. During my field study, it emerged that the building was identified with one of its famous residents: Hans Adolph Brorson (1694-1764), bishop of Ribe and hymns writer. That was the first time I realised that antiquities are looked at as they were from one particular point in time, from a synchronic perspective. Specifically Taarnborg was identified with Brorson who lived in the first half of 1700, while the building is mentioned in earlier documents dated to the 1440. Therefore, I focused my design process on creating an interactive environment, so as to represent the flow of lives related to the building through time, from a diachronic perspective.

During my master thesis, I designed and tested a new computer-augmented board game for Philips Research called *Cheese Hunters* (Fig. 1). Since board games are a low-tech activity, my study focused on investigating their nature and what digital technologies had to offer. As a result, I found that board games are a form of social-theatrical improvisation, in which players tease each other, reflecting in a complex way upon the game situation as if it was real. These findings inspired me to investigate if this particular interaction could enhance learning of history in museums, emphasising the diachronic perspective.

Shortly after my thesis, I started to formulate my project proposal through a literature review and a museum survey in Denmark. The focus of this survey was on interactive exhibits and activities offered to visitors by local museums and their approach towards the diachronic perspective.

As a result, it was observed that most learning activities, tangible and walk-through installations (Fig. 2, 3) focused on providing the visitors an immersive experience of the past by creating an illusion of being "there." On the other hand, history as a process is communicated through verbal language with the support of: explicative signs, publications, lectures, and guided tours. The risk of this approach is to hide the actual complexity and meaning of historical processes, which represent a complex intertwining of sociocultural and natural factors, and reduce them into sequences of facts.

Figure 1. The final prototype of the board game *Cheese Hunters*.

Figure 2. Viking Age longhouse, Esbjerg Museum.

Figure 3. Medieval toys, Viking Museum in Ribe.

Therefore, I decided to explore how to extend the approach adopted by museums, introducing experiential-tangible tools to discuss history as a social process. Thus, the core question of my doctoral project and my thesis is how to transpose historical processes into playful interactions and enhance the role of museums as context for learning practices.

1. Introduction

Traditionally historical museums acted as "uncontested authority," (Reeve and Woollard 2006, p. 5), responsible for the creation and dissemination of culture through collection, restoration, preservation, and display of rare antiquities. Museum practitioners approached their audience as a self-reflected projection: educated adults with a passion for a particular subject; as a consequence, little attention has been given to different target groups (Star and Griesemer 1989; Reeve and Woollard 2006). The phrase "museum practitioners" is used in this thesis as a generic term to indicate professionals involved in museum practice, such as: guides, educators, museologists, and curators. The phrase "museum practitioners" is inspired by Donald Schön's notion of "reflective practitioner" (Schön 1994). According to Schön, reflective practitioners are professionals, who through academic education and experience have developed an inventory of cases and critical thinking skills, enabling them to apply strategies they adopted in previous cases to new ones. Similarly I see museum professionals as reflective practitioners, who refer to their inventory of past cases when planning new exhibitions and other learning activities for the visitors. Museum practitioners communicate to the visitors through museum learning practice, which is seen in this thesis as the set of activities and interactions taking place during the encounter between the visitors and the museum. The aim of museum learning practice is to enable the visitors to learn through the museum exhibition and it involves different practices such as: collection and planning of exhibitions (Janes 2009), guided tours, and workshops in which the visitors have to engage in different creative activities (Best 2012; Ritchhart 2007), and conferences and publications in print and digital format (Lang et al. 2006). Museum practitioners do not form a uniform group, but include individuals with different competences, roles, and needs with respect to how they participate in museum learning practice and communicate with the visitors. Data gathered through my field study (see chapter 5) suggest that guides and educators are responsible for conducting guided tours and they directly interact with visitors. On the other hand, museologists and curators are responsible for the organisation of exhibitions and of educational activities, and do not directly interact with visitors. In this thesis, I use museum practitioners as a general term to identify museum professionals who have specific needs with regard to technology and museum learning practice, but the specific terms of guides, educators, museologists, and curators are mentioned when relevant in relation to the specific topics discussed in this thesis.

According to the traditional picture of museum learning practice, which is mentioned above, museum practitioners focus on the collection of rare pieces and address habitual visitors with a clear understanding of the collection. Certainly a lot has happened since the beginning of this study, which officially started in 2010-2011, and what I found was that the traditional picture of museum learning practice was being questioned from many sides, among which ministries of education and culture, city councils, academics, and museum practitioners themselves (Søndergaard and Janes 2012; Janes 2009; Reeve 2006; Hooper-Greenhill et al. 2000) (Figure 1). As a result, museum learning practice is going through critical changes, under the pressure of external institutions (as detailed in Paper 1 and represented in Figure 1 by the lower, left-most elements), in relation to the ability of museums to attract more visitors (Crowley and Jacobs 2002), museums' productivity and management of resources (Janes 2009; Reeve 2006), and museums' offer to the visitors and to society (Dysthe et al. 2012; Reeve and Woollard 2006; Fleming 2005). I have noticed that literature dealing with museum learning practice tends to use the term "shift" to refer to the different changes affecting museum learning practice. For instance, Fleming (2005, p. 4) argues that a "there has been a massive shift from passive learning to active learning," as museums have recognised that they have to rethink their methods and create "new connections, new languages, new techniques and, most of all, new attitudes" if they want to broaden their relevance and scope. At the same time, Reeve and Woollard (2006, p. 5)

claim that: "over the past 50 years, there has been a major shift in the relationship between museums and their audiences," in which museums are recognising that their audience is made up of diverse groups "who are keen to articulate their needs and make their views known, even through choosing not to visit." Janes (2009, pp. 36-37) talks about "a paradigmatic shift from collection-driven institutions to visitors-centred museums," even though collection still remains a major activity for museums. Summing up, different authors acknowledge one or more on-going shifts in the role of museums, mainly in their shifting of focus from collection to audiences and from passive to active learning. A consequence of this or these shifts is the exploration of new methods or techniques (Fleming 2005), among which is the introduction of digital technologies within museum learning practice (Lang et al. 2006; Hornecker and Stifter 2006).

In this thesis, I use the phrase "the shift in the role of museums," in order to refer to the on-going shifts discussed in literature. Moreover, building on Rogoff (1990) in the specific case of this thesis, the shift in the role of museums is seen as a historical change introducing new approaches and technologies within museum learning practice, affecting how individual visitors and museum practitioners interact with each other and engage in learning practice.

Several studies claim that these shifts have already produced positive results in increasing the quality of museum learning practice (Crowley and Jacobs 2002; Fleming 2005; Reeve and Woollard 2006). New learning and entertaining activities, also involving digital technologies, have been created to support people with disabilities, different ethnic and age groups (Reeve 2006; Fleming 2005; Crowley and Jacobs 2002). However, the study discussed in this thesis suggests that the shift in the role of museums is still unsettled, specifically in relation to the digitisation of museum learning practice, the introduction of digital technologies within museum learning practice (Lang et al. 2006) (as discussed in Paper 1 and 5).

Different perspectives have emerged about these shifts, emphasising either how individual participants are affected (visitors versus museum practitioners (Hornecker and Stifter 2006)) or how new values are emerging in museums as institutions (Dysthe et al. 2012). In general, most studies can typically be positioned on two parallel discourses (Fig. 1) that in this thesis are discussed further in chapter 2 and Paper 5:

- **A micro level discourse** that deals with what happens inside a specific museum, from the individual perspective of visitors and guides/educators;
- **A macro level discourse** that deals with the role of museums within their local community and society in general, and also their relations to external institutions.

These two discourses emerged from the literature review I conducted for this thesis. These are not explicitly mentioned in current research, but are implicitly acknowledged and discussed. In my literature review, I have especially focused on literature within interaction design and museum studies.

Interaction design is a broad area of studies related to the field of human computer interaction and design. As design can in general be defined as the discipline concerned with the conception of material artefacts (Cross 2006), the area of interaction design is more specifically concerned with the creation and interaction of digital artefacts. Interaction design leverages on methods such as user centred design (Preece et al. 2011) and participatory design (Druin 2002), where the designers engage in a dialogue with their users from early stages, so that the final artefact meets the needs and values of the users involved (Sanders 2002).

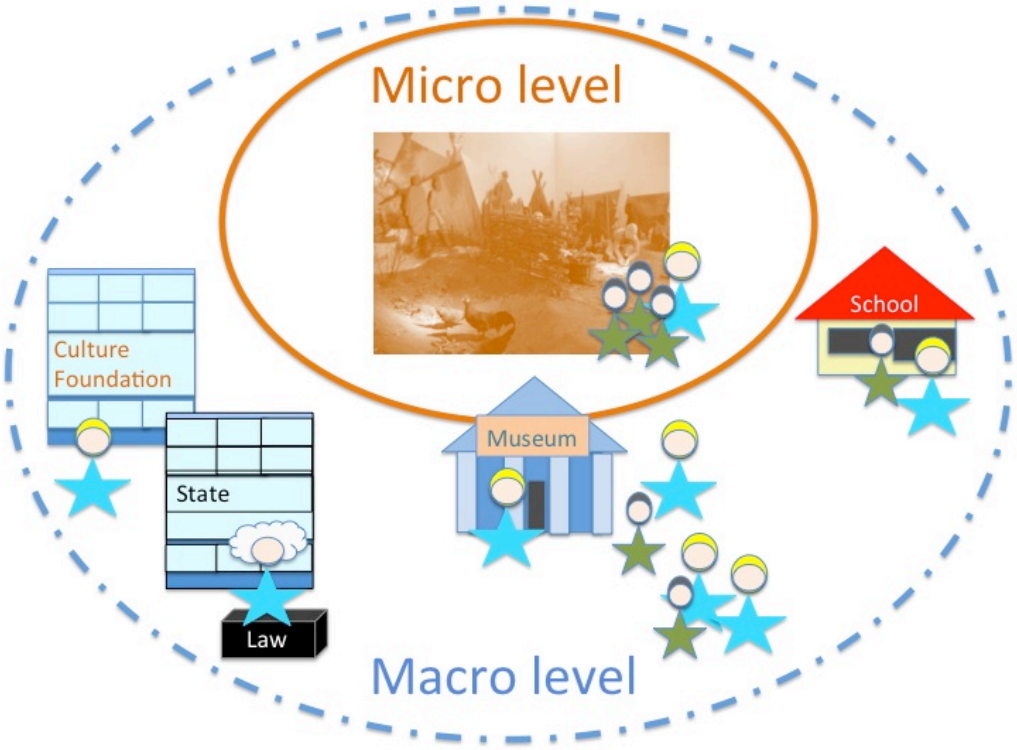

Figure 1. Micro and Macro level discourses in museum innovation. The micro level represents the inside of a specific museum. The macro level represents the context in which museums operate (figure from Paper 5).

The relationship between design and research is further discussed in chapter 4, section 4.1. This thesis refers to the specific area of interaction design research dealing with the investigation of the role of technology within museum learning practice, through the creation and/or evaluation of new digital technologies developed for museums from the perspective of the visitors, for instance as discussed in Hornecker and Stifter (2006) or Dindler and Iversen (2009). I found out, as presented in chapter 2, that studies in the area of interaction design seem to focus on micro level discourse, analysing visitors' responses to interactive exhibits (Muise and Wakkary 2010; Hornecker and Stifter 2006).

Museum studies also represent a broad interdisciplinary area of studies, combining theoretical perspectives, for instance from arts, anthropology, sociology, learning, and others. This thesis builds on museum studies concerned with the concepts, issues, and evaluation of museum learning practice (Lang et al. 2006), including philosophical values (Dysthe et al. 2012) as well as daily practices (Best 2012). In general, it emerged that this category of museum studies tends to focus on the macro level discourse, analysing how the role of museum practice and its cultural value for society is changing (Janes 2009; Reeve 2006; Hooper-Greenhill et al. 2000). However, a few works in the area of museum studies combine the two discourses to evaluate how the shifts are affecting specific museums' learning practices on the macro level and affecting the visitors on the micro level (Dysthe et al. 2012; Hooper-Greenhill et al. 2004). Micro and macro level discourses are combined also in the few studies dedicated to guided tours. Guided tours are discussed in these studies as a little studied but common practice in museums (Best 2012). Guided tours can be defined as an interactive learning practice (Best 2012), where visitors are verbally and physically introduced to the museum exhibition by guides/educators, who are in charge of explaining the historical meaning of the pieces displayed in the exhibition. In these studies, the role of the guides is analysed from a micro level perspective, in relation to how they interact with the visitors during a specific tour (Best 2012; Ritchhart 2007). From a macro level

perspective, the role of the guides is also analysed in relation to how they contribute to the role of museums within society (Dysthe et al. 2012; Ritchhart 2007). However, since few studies specifically address guided tours, little is known about how this practice takes place and how digital technologies could contribute to it (Best 2012).

The studies conducted by Dysthe et al. (2012), Ciolfi (2012) and Hooper-Greenhill et al. (2004, 2000) are a main reference for this thesis, as these analyse the shift in the role of museums through specific cases. Hence, these studies provide richer insights to the understanding of museum learning practice and its related shifts, from a micro and macro level perspective.

1.1 Conceptual framework and empirical study

This thesis has the ambition to bridge micro and macro level discourses, proposing an inclusive framework not only to support designers and design researchers who are interested in creating technologies for museum learning practice, but also museum practitioners who have interest in experimenting with digital technologies and new learning approaches. This inclusive framework has to be seen in part as an early result that emerged from my literature review and field study, but also as a point of departure for the design process. I started my study focusing on two main topics: first I wanted to investigate how digital technologies could support museums in communicating knowledge about historical processes, and second how digital technologies could contribute to the practice of guided tours. As I approached the museums involved in this study, interviews with the practitioners made me realise that these practitioners felt to be constrained by socio-political and financial matters in curatorial and learning practices; this finding is confirmed by museum studies such as Reeve and Woollard (2006) and Janes (2009), and the interaction design study McCaw et al. (2014). Hence I started to include administrative and financial matters in my design process, together with social interaction and learning. In this way, I approached museum learning practice and the guided tours bridging micro and macro level discourses.

The term inclusive is used in this thesis to indicate the need of including both micro and macro level discourses in the design of new digital technologies, to enrich museum learning practice. The term "inclusive" is borrowed from the design of accessible interfaces for individuals affected by disabilities, where the goal is to create technologies that as many people as possible can use, in line with the design for all philosophy (Abascal and Nicolle 2005). A key principle of inclusive design is that key users (patients and care-takers) should be involved in the design process from the beginning of the design process, in order to meet their needs in relation to their practice and the context in which they operate (Jönsson 2005). In this way I use the term inclusive in analogy with inclusive design, to suggest that all the key users should be involved in the design process in order to bridge micro and macro level discourses. Furthermore, always in analogy to the original notion of inclusive design, the targeted inclusive framework is aimed at contextualising the design process with respect to what takes place inside a specific museum, between the group of visitors and the guides or educators, similarly to what happens between patients and care-takers. In this respect, a relevant example from the domain of design for accessible interfaces is provided by Petersson (2006), who involved care-takers in the evaluation of technologies targeted at ludic engagement of children with special needs, even though the care-takers were not specifically part of the target group. In this way, it was possible for Petersson to frame her own studies in relation to the needs of the children with respect to their institutional context, which includes their everyday activities and their care-takers, integrating micro and macro level discourse. Similarly, this thesis aims at bridging micro and macro level discourses to frame the design process and theoretical reflections, with respect to the institutional level of museum learning practice.

In order to achieve this inclusive perspective, museum learning practice is approached as a sociocultural activity, which in this thesis is understood as a human activity emerging from the interplay between the individual participants and their context, as according to Rogoff (1995). For instance, guided tours can be defined as a sociocultural activity emerging from the interplay between the individual visitors and guides participating in it and the context of museum exhibition. I consider Rogoff's perspective on sociocultural activity useful in achieving the desired inclusive framework as it considers the context intended as the material space as well as the surrounding community as an integral aspect of sociocultural activity, so that according to Rogoff (1995), activity and context cannot be separated.

Following this, Rogoff defines the sociocultural context as the material environment and available artefacts, norms and traditions, all viewed from a societal/community perspective (Rogoff 1990, 1995, see chapter 3). In the case of museum learning practice, the museum itself, including its collection and eventual interactive exhibits, provide the material environment. Museum learning practice is also defined by norms and traditions that have emerged through time and represent the values of a specific society.

This thesis introduces a distinction between digital and tangible exhibits to discuss the different kinds of interactive exhibits that can be displayed in museums. In my study, I found that museums displayed many tangible exhibits, which I define as interactive exhibits aimed at enriching learning and visitors' experience, but designed with non-digital materials. Tangible exhibits can for instance include walk-through reconstructions of environments or reproductions of small objects and tools that people can interact with enter the category of tangible exhibits. Digital exhibits are defined as interactive digital technologies designed to be displayed in a museum's exhibition. The term "exhibit" in digital exhibits is supposed to emphasise that these technologies should be regarded as part of museum exhibitions, as well as other displayed artefacts. Digital exhibits could include for instance digitally augmented reconstructions of environments and tools.

An empirical study has been conducted in two museums, The Viking Museum in Ribe (DK) and The Transport Museum in Coventry (UK). The empirical work consisted of an ethnographic field study: a participatory design process and a series of preliminary and final evaluations of a prototype. The design process involved a group of 25 primary school children in co-designing a prototype, as well as curators, guides, and a pedagogue. During this study, I found that guided tours are a common practice in the two museums, where these are recommended to enable children in grasping the knowledge embodied in the exhibition. Therefore, the design process focused on investigating how young visitors and museum practitioners related to the practice of guided tours and also to the introduction of digital technologies within museum learning practice.

The design outcome is called "MicroCulture," an interactive simulation[1] of the development of Ribe with a tangible interface, which attempts to reproduce key elements of the foundation of Ribe, focusing on the role of infrastructures and authority in urban development. MicroCulture has been evaluated twice: the first time a set of preliminary evaluations was run with the guides, the curator, and the pedagogue in order to fine tune the prototype before the final evaluations, which involved three different groups of children during three different tours with the guides. The final evaluations were intended to evaluate if and how MicroCulture could enrich the practice of guided tours and facilitate learning of history inside the museum.

---

[1] For a detailed discussion on the notion of MicroCulture as a simulation see chapter 6, section 6.3.

[2] The theory of Carr about historical facts is discussed further in chapter 3, section 3.4.

1.2 Research Questions

This section discusses the research questions that are addressed in this thesis. The research questions are structured into a main research question, which represents the problem domain from a broad perspective, and three sub-questions representing more specific sub-problems. These questions were formulated starting from the literature review (reported in chapter 2) and from initial findings from the empirical study, in particular in relation to museum learning practice and the practice of guided tour. The empirical study discussed in this thesis aims at investigating:

How is it possible to conduct a design intervention that could contribute to the shift in the role of museums?

To investigate this general research question, the following sub-questions are also explored through the empirical study:

- Which sociocultural factors are involved in the design of technologies targeted at museum learning practice and young visitors?
- How can digital technologies contribute to the practice of guided tours (as a concrete example of museum learning practice)?
- How can a digital exhibit enrich learning of history inside the museum?

How is it possible to conduct a design intervention that could contribute to the shift in the role of museums?

This main research question deals with the goal and framing of the design process, suggesting that museums should not be regarded only as a place where the visitors can learn or enjoy themselves, but as dynamic organisations affected by changes.
My initial findings about the use of material artefacts in facilitating learning of history suggest that these artefacts displayed in the museum, digital or not, affect the visitors as well as the guides in performing their role of facilitators for the visitors. Reeves and Woollard (2006) argue that the shift in the role of museums is affecting the museums' freedom of innovation (Reeves and Woollard 2006) as well their approaches to learning (as discussed also in Paper 1). More recent studies seem to suggest that the on-going shift (or shifts) has lead towards the emergence of interdisciplinary approaches, which can better support museum practitioners dealing with emerging issues and challenges. These studies discuss either cases of interdisciplinary collaborations among the different practitioners of the same museal institutions (Hosker et al. 2014), or of collaborations involving external designers as consultants (Ciolfi 2012; Roberts 2015). Hosker et al. (2014) for instance discuss how interdisciplinary cooperation among different practitioners has lead towards the identification of new opportunities for improving the audience's access to the collections owned by Oxford University. Ciolfi (2012) argues that designers could facilitate the sharing of new understandings of heritage, if they adopted a new inclusive perspective that leverages on the different competences surrounding museal institutions. Finally Roberts (2015) argues that the design of digital exhibits should be regarded as an interdisciplinary field in its own right, which builds on art, architecture, and communication.

I find that these studies provide meaningful insights in relation to how can designers deal with the interdisciplinary nature of museum learning practice. Moreover, these studies seem to suggest that the shift in the role of museums plays a central role in changing how museum practitioners perceive their practice and the required competences. This change could affect how museum practitioners engage in innovating their practice, for instance recent financial cuts might have affected choices of pedagogical and digital materials, as it is acknowledged in literature (McCaw et al. 2014; Lang et al. 2006). This in turns implies that designers should address the different needs of visitors and those of practitioners, in order to make sure that their solution will be adopted.
In this respect, I consider these studies as a point of departure to reflect more explicitly on how can design practice contribute to the on-going shift, also taking into account the administrative dimension of museum learning practice, which deals with socio-political and financial matters. The first step in this direction would be to investigate during my field study how the on-going shift is affecting local museums and practitioners, in order to gain more specific insights regarding the digitisation of museum learning practice and of the guided tour. From a more practice-oriented perspective, this main question aims at investigating through the design of MicroCulture how a design process and its outcome should approach the museum context, in order to contribute to the needs of both visitors and museum practitioners. The analysis of the gathered data are expected to provide also design requirements in relation to which technologies could be used and how these technologies should support practitioners and visitors. This thesis is based on the assumption that to achieve this contribution, the design process should attempt to bridge micro and macro level discourses, addressing learning practices existing in specific museums from both perspectives, similarly to the studies of Dysthe et al. (2012), Ciolfi (2012), and Hooper-Greenhill et al. (2004, 2000). It is in this sense that these studies set a main reference for this thesis.

Which sociocultural factors are involved in the design of technologies targeted at museum learning practice and young visitors?

The formulation of the first sub-question attempts to discuss and build on different views emerging from literature in one theoretical investigation, aimed at gaining knowledge of the key factors that are affecting the digitisation of museum learning practice, and more concretely at defining what designers should know in order to contribute to museum learning practice. By the term "sociocultural factors" I mean those key factors that emerge from the sociocultural context in which museums operate and that participate in the understanding of museum's role within its community. Therefore, museum learning practice is investigated in this thesis through a sociocultural, inclusive perspective, according to which practitioners and visitors shape and have shaped museum learning practice through time, in relation to their sociocultural context, which is constituted by traditions, norms, values, and available material artefacts (Dysthe et al. 2012; Rogoff 1995). For instance, museum learning practice can be defined in relation to the norms and traditions related to how guided tours take place inside the exhibition rooms. Recent literature has engaged in investigations about the factors affecting for instance the role of designers in the creation of exhibits (Roberts 2015), and of sociocultural factors affecting visitors' learning gains (Apostolellis and Bowman 2015). The study conducted by Roberts focuses specifically on how designers are involved in projects run by museums and aimed at the design of new exhibits. In general her study argues that design is not perceived as a central discipline in the creation of new exhibits and this has implications for the social conditions in which designers have to work. For instance museums might disregard the importance of involving users early in the process and of iterative prototyping practices (Roberts 2015). However, this study does not discuss how the visitors benefit or not from iterative design practices, or how are the visitors involved in the concrete cases she discusses. Apostolellis and Bowman (2015) instead focus on how sociocultural factors, like interest and expectations, affect how visitors acquire new

knowledge while interacting with digital exhibits. At the same time the two authors do not discuss in depth the role of guides and do not discuss what digital exhibits could offer to guided tours or museum learning practice in general. I find these two studies interesting, as they seem to move towards the inclusive perspective proposed in this thesis, yet they focus either on visitors or on the designer's work. Moreover, these studies keep micro and macro level discourses separated, as the discussion on the visitors focuses on what happens inside the specific museum from a micro level perspective, while visitors engage with technologies; the discussion on the designer's work focuses instead on the relations between museum and design practice, from a macro level perspective.

As a result these studies contribute only to a limited extent to understand which sociocultural factors are involved in current museum learning practice and its on-going digitisation. For instance, Apostolellis and Bowman argue that personal interest and motivation are key factors affecting how visitors learn inside the museum. Roberts identifies different factors such as the timing of the involvement of the designer, if the designer is involved at a mature stage of the project, he or she would not be able to make a significant contribution. The experience and attitude of the museum in relation to design practice and visitors is also found crucial by Roberts, as museum practitioners' lack of experience in design practice will leave to the designers the responsibility of taking charge of the management of the design process.

Therefore, the empirical study discussed in this thesis is aimed at providing new knowledge about the sociocultural factors that are affecting the introduction of digital technologies within museum learning practice. Moreover, sociocultural studies such as Rogoff (1990) and Vygotsky (1978) are seen as providing meaningful theoretical grounding for this thesis in order to gain an understanding of what is a "sociocultural factor". This new knowledge is expected to contribute to bridging between micro and macro level discourses, providing a more inclusive understanding of the role of the digitisation of museum learning practice. Finally from a practice-oriented perspective, this knowledge is expected to support designers, in their effort of contributing to museum learning practice.

How can digital technologies contribute to the practice of guided tours, as a concrete example of museum learning practice?

The second sub-question restricts the research and design focus on guided tours as the main unit of analysis. This question has methodological implications defining the specific learning practice addressed by the design process. In this respect, the guided tour is addressed as a typical but little investigated learning practice, as according to Best (2012). More recent studies have provided some contributions to the knowledge of guided tours, but mostly in relation to the role of guides in visitors' experience. For instance Apostolellis and Bowman (2015) have acknowledged that visitors engaging with digital exhibits have greater learning gains when facilitated by professional guides. However, the authors themselves argue that their study does not specifically take into consideration the richness of museum learning practice. In relation to my study I find that even though Apostolellis and Bowman discuss the role of guides, they do not discuss guided tours or how digital technologies could contribute to that practice. At the same time, Ciolfi (2012) argues that guides play a key role in enriching visitors' experience bringing the exhibition to life, but that they are little involved in curatorial practice. Finally Dindler and Iversen (2009) and McCaw et al. (2014) provide critical insights on the limitations of guided tour practice, which are depicted as leaving little freedom to the visitors to engage with the exhibition space and appealing to a restricted target group. Other studies discuss the design of digital exhibits targeting one specific activity, in which visitors engage in during their visit. For instance Lyons et al. (2015) aim specifically at facilitating tinkering with electronic components in the science museums; Roberts et al. (2014) aim at interpretation of complex visual data. Muratsu et al. (2014) focus on scientific inquiry in the science museum; Muise and Wakkary (2010) instead designed a hybrid system to facilitate family tours. I find interesting the emergence of the need for designers to support a

specific activity, as it is argued by Lyons et al. (2015). However, activities arranged by museums, like guided tours or workshops, still appear to be little investigated. Hence as argued by Best (2012) it is still unclear how the current practice of guided tour could be enriched by digital technologies. Based on these insights, this thesis has the ambition to add knowledge about how guided tours are taking place in the museums involved in this study, about how these are perceived by practitioners and visitors, and on which role digital technologies could play within this practice. On a practice-oriented perspective this knowledge could be useful for future design interventions in museums, targeting the guided tours. Therefore, during the field study, guided tours have been observed in the museums in Ribe (Denmark) and Coventry (UK), to find out more about how guides and children interact and participate in the tour and how knowledge is acquired by the children. The guided tour is seen as a sociocultural activity defined by participation and learning (Best 2012; Dysthe et al 2012; Rogoff 1995), which is contextualised within museum learning practice and the shift in the role of museums. In this thesis I analyse guided tours as a sociocultural activity, unfolding from the interplay between the guides and the children within the context of museum, which is not only affected by the traditions and norms of the museum context, but also innovated by the interaction unfolding among the individuals involved.

How can a digital exhibit enrich learning of history inside the museum?

The third and last sub-question specifies that the aim of the design intervention is to enrich learning of history inside the museum. The formulation of this question builds on different examples of current literature mainly dealing with the nature of historical knowledge and with how learning of history takes place inside the museum. Historical knowledge has been investigated from different perspectives, for instance Carr (2001) argues that historical facts emerge from a later analysis of complex social processes, to which different individuals have, more or less consciously, contributed[2]. This analysis focuses on the interpretations of different written or material sources, which might be contemporary or posterior to the time of the specific fact. The studies conducted by Schofield (2002), Ciolfi (2012), Iversen and Smith (2012), and Dysthe et al. (2012) have investigated the role of museums in creating historical knowledge and implicitly acknowledge Carr's understanding of historical facts as the result of a later analysis. For instance Schofield (2002) sees museums as the main authority in conducting this analysis, as through curatorial practice museums select at the same time which artefacts will be included in future exhibitions and which historical facts will be remembered. Schofield's view seems to match the traditional image of museums, while the more recent Dysthe et al. (2012) argue that the on-going shift is turning museum learning practice into a dialogic, participatory practice. Moreover, Ciolfi has identified in social media an "effective" digital platform in facilitating visitors to contribute to curatorial practice through sharing, communication, promotion and creation of new exhibitions (Ciolfi 2012, p. 73). At the same time Iversen and Smith (2012, p. 126) are looking at the "museum as a connector" and social media are seen as enabling visitors to reshape the exhibitions expressing themselves and communicating with each other. In other studies the interaction between visitors and guides (Best 2012; Pierroux 2010; Ritchhart 2007), and between the visitors and the physical lay-out of museum exhibitions (Fienup-Riordan 1999) are considered as fundamental aspects of learning of history inside the museum. Finally looking at interaction design studies, most contributions discuss the evaluation of newly developed digital exhibits targeting learning of sciences, as shown for instance by the studies of Lyons et al. (2015), Apostolellis and Bowman (2015), and Muratsu et al. (2014). In these studies the authors aim at

[2] The theory of Carr about historical facts is discussed further in chapter 3, section 3.4.

supporting the hands-on experience provided by science museums. Other interaction design studies propose new digital exhibits focusing more specifically on history and heritage, such as Lischke et al. (2014), McCaw et al. (2014), Ciolfi (2012), Iversen and Smith (2012), and Muise and Wakkary (2010). The already mentioned Iversen and Smith (2012) and Ciolfi (2012) are particularly interesting, as they also provide rich insights on how the role of the museum is shifting in the creation and communication of historical knowledge. Interestingly the studies of Lyons et al. (2015), Apostolellis and Bowman (2015), and Muise and Wakkary (2010) leverage on social forms of play as a resource for learning and interaction among the visitors. However, it is not clear from these studies how digital exhibits could contribute to the communication of historical knowledge that is relevant for the primary school pupils and their curriculum, an important goal of museum learning practice as claimed in Reeve and Woollard (2006). In this respect, I will attempt to add new insights in relation to how history can be communicated when technologies are introduce within guided tours, and also how curricular knowledge and specific historical processes, like urban development, could be conveyed to learners in an engaging way.

Therefore, this last sub-question aims also at gaining knowledge about how local museums relate to learning of history inside the museum and which strategies they have developed to support young visitors. At the same time, I aim at investigating how young visitors relate to learning of history and how they would like to be supported by digital technologies. I expect this knowledge to have implications in relation to how digital technologies could contribute to this practice, and in providing design requirements for my design process and the creation of my new digital exhibit, MicroCulture.

1.3 Sociocultural grounding, focus and contribution

This thesis builds on sociocultural studies, specifically on Rogoff's studies about sociocultural activity in context of learning (1995, 1990) (Fig. 2) in order to achieve an inclusive perspective about the digitisation of museum learning practice.

The term sociocultural comes from a particular approach to the study of the development of the human mind, based on the premises that higher psychological functions originate from the interplay between the individuals and their social, cultural, historical, and institutional context (Rogoff 1995; Vygotsky 1978). From this approach, a general theoretical perspective was developed. This thesis is inspired by Rogoff's studies on sociocultural activity. Rogoff (1995) argues that human activities should be studied integrating individual and societal perspectives (which I call micro and macro level discourses). According to Rogoff, participation in sociocultural activities enables children to acquire new knowledge, preparing them to actively participate in their communities (Rogoff 1995, 1990). Hence, sociocultural activities and the resulting learning takes place across the individual and societal planes, so that the study of sociocultural activity requires researchers to combine both perspectives (Rogoff 1995). Rogoff's understanding of sociocultural activity is discussed further in chapter 3. Similarly, museum learning practice, seen as a sociocultural activity, takes place across the personal and interpersonal planes of the individual participants and the community plane of the specific context in which the museum operates.

From a methodological perspective, this study takes inspiration from design-oriented research (Fallman 2003). This means that this inquiry was conducted through a design process, with the goal of gaining a knowledge contribution, as further discussed in chapter 4.

The initial stage of this study (literature review and field work) has a broader focus of investigation combining insights from different research fields, with the goal of establishing an

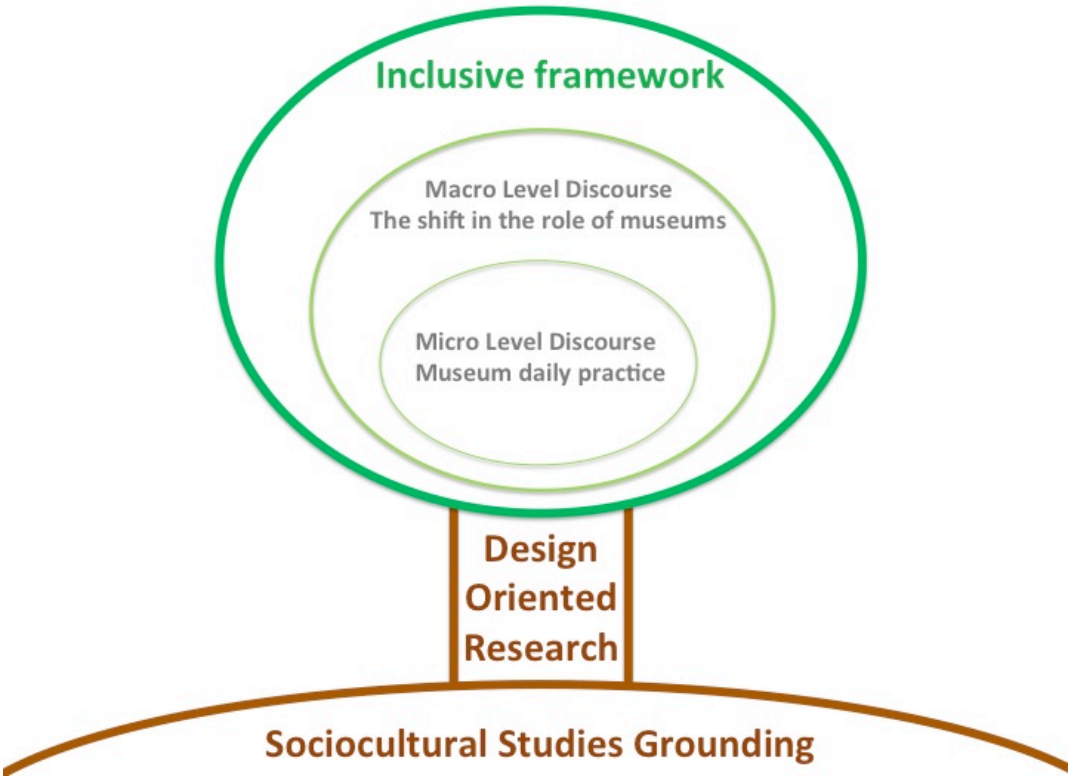

Figure 2. Sociocultural studies provide grounding the empirical study, in order to formulate an inclusive framework enabling to combine micro and macro level discourses.

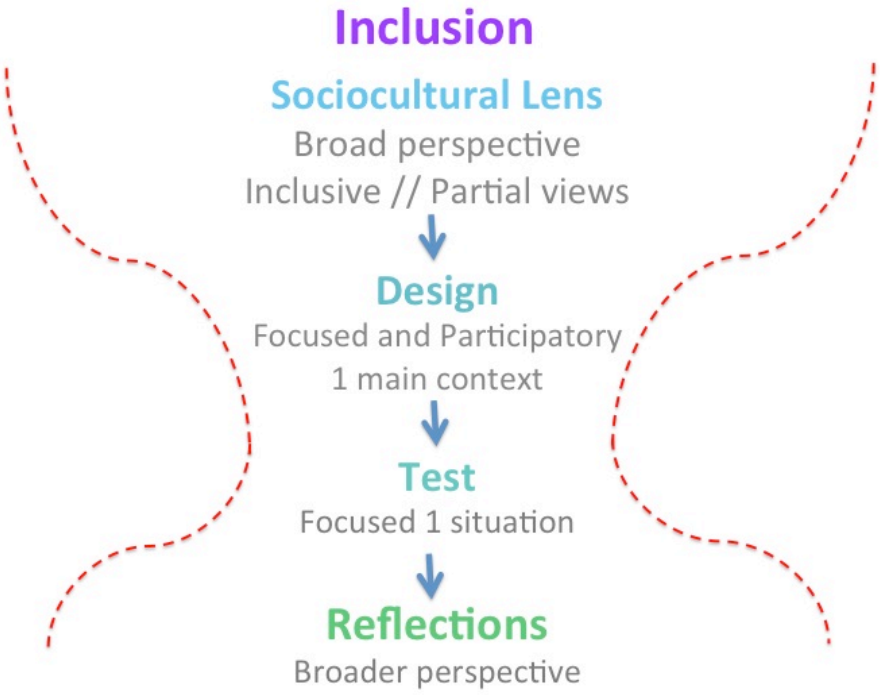

Figure 3. Shift of focus of the study and of the thesis, from an initial broad perspective, to a more narrow design process and evaluation, to conclude with a broad perspective in the analysis and reflections on gathered data.

inclusive framework combining micro and macro level discourses. Then, the focus of the study becomes narrower in relation to the design process (as visible in Figure 3), in order to meet the demands to create one prototype and conduct a coherent evaluation. Finally, the data gathered from the final evaluation are analysed through the broader perspective of the proposed inclusive framework, so to critically reflect on how the design outcome affects museum learning practice and addresses the research questions. This shift in focus, from broad to narrow then broad again (Fig. 3), proved fruitful since it allowed to investigate each sub-question bridging between micro and macro level discourses, and to achieve an inclusive view on the role of digital technologies within the on-going shift in the role of museums.

Starting from the given grounding, two kinds of research contributions are expected from this thesis:

1. **A theory-oriented kind** in the form of a new inclusive framework to analyse and design for museum learning practice, new insights on the fragmentation between micro and macro level discourses and on museum learning practice and its on-going shift, which build on the interdisciplinary perspective I have adopted in this thesis;

2. **A practice-oriented kind** in the form of the creation of a new digital exhibit, new concrete knowledge about museum learning practice and the specific practice of guided tours, and how these are affected by the introduction of digital technologies.

1.4 Overview of the included research papers

A selection of five articles and papers is included in the last part of this thesis to provide an overview of the research contributions that emerged through the study and to discuss how these contributions address the research questions. This selection includes 2 full research papers published in conference proceedings (Paper 1 and 2), 2 book chapters (Paper 3 and 4), and a journal article (Paper 5). The selected papers focus on two main topics: (1) the role of technologies within the on-going shift and museum learning practice in Paper 1 and 5, and (2) how digital technologies could enrich guided tours and exhibition practices, which is discussed from a learning and design perspective in Paper 2, 3 and 4. Both topics are examined in relation to macro and micro level discourses and to the different points of view of the users involved in the study: primary school children and museum practitioners.

In the following sections, an overview of the papers is provided, presenting their aim, research methods, and main results[3].

1.4.1 Paper 1. Shift in the role of museums and innovation practices

Paper 1. Marchetti and Nandhakumar 2011

The first paper presented in this thesis proposes an analysis of the process of the on-going shift in the role of museums. The paper builds on the literature review and empirical data gathered during the field study at The Transport Museum in Coventry and The Viking Museum in Ribe.

[3] For details about methods and results see respectively chapter 4 and 7.

Paper 1 discusses the challenges that museums are facing in relation to the on-going shift and museums' relations to external institutions.

The paper builds on Law and Callon (1992), who claim that innovation processes cannot succeed without a favourable global network. Starting from Law and Callon (1992), it is argued in Paper 1 that the shift in the role of museums, (called in Paper 1 the process of museum innovation) is stuck, because museum practitioners feel that external institutions responsible for funding and education are posing conflicting requirements, such as becoming creative and entrepreneurial at the same time (Fleming 2005; Hooper-Greenhill et al. 2004). Such requirements are seen as creating a double bind (Bateson 1972), a situation in which a clear way to succeed is missing. As a result, explorations of new exhibits are confined to an emergent practice, which I call in the paper "innovation enclosures" and it is defined as the systematic creation of minor, temporary, or thematic exhibitions, besides the main exhibition. In this paper, I argue that the emergence of innovation enclosures in the two museums indicates that a clear vision for the role of digital technologies in museums is missing. For this reason, the curators from the two museums did not alter the main exhibition despite their desire to try new solutions. Furthermore, digital technologies are still not integrated in neither of the two museums and are perceived as expensive and potentially disruptive.

This paper addresses the first and last research questions and aims at constructing an overview of museum learning practice and the challenges involved in the shift. This paper combines macro and micro level discourses as it reflects on the connection between museums' institutional challenges such as the presence of external pressure (macro level), to the emergence of similar practices inside the specific museums such as innovation enclosures (micro level).

1.4.2 Paper 2, 3 and 4. Guided tours, learning, and play

Paper 2. Marchetti and Petersson Brooks 2012a

Three papers are devoted to the learning and design aspect of the study (Paper 2, 3, and 4), analysing how learning takes place inside the museum and how it could be enriched, mainly from the perspective of micro level discourse.

The first paper of this kind (Paper 2) proposes an analysis of guided tours and defines a new scenario building upon Rogoff's (1990) framework of apprenticeship in thinking. According to Rogoff (1990), children acquire new skills and knowledge engaging in goal-directed activities together with expert adults, who support them when reaching their zone of proximal development, defined as the threshold between what they know and what they can learn (Rogoff 1990; Vygotsky 1978).

The discussion of the paper is based on data collected through interviews and observations conducted during the field study, which is aimed at designing an interactive representation of urban development during the Viking Age. From the study, it emerged that the goal of guided tours is to enable young visitors to learn about ancient artefacts and historical processes, like the foundation of settlements and cities. Specifically, the two museums focus on the development of Ribe into the first Danish town and the growth of Coventry into an industrial town. In this paper, I argue that during guided tours, historical knowledge is communicated through a form of lecturing, which might reduce historical processes into sequences of facts, hiding their actual complexity and meaning. Starting from Rogoff's theory, Paper 2 proposes instead to turn guided

tours into a playful apprenticeship, enabling guides and children to play and experience together how it could have felt to participate in the foundation of Ribe in the Viking Age.

Paper 3. Marchetti and Petersson Brooks 2012b

Paper 3 develops further the argument presented in Paper 2, focusing on children's needs with respect to the design of digital exhibits. The theories of Sutton-Smith (1997) and Henare et al. (2007), respectively regarding play as an exploratory individual experience and mediated interaction (called in the paper object-mediated interaction), constitute the theoretical framework of the paper.

Paper 3 builds on data gathered through the participatory design process, in particular the free tour in the Danish museum and the 4 workshops conducted with design materials and with the low-fidelity prototype. During these events, the children showed individual preferences regarding their play and museum experience. Some children showed a distinctive preference for social or individual experiences and for different forms of play, mainly a designerly and a competitive form of role-play. The children engaging in designerly play enjoyed themselves making new artefacts that fitted within the theme of urban development and the Viking Age, while the children engaging in competitive play considered designerly play as a preparatory stage, in which they made their own game pieces, afterwards they played as if they were playing with a board game. Building on this evidence, it is argued that the design of digital exhibits should aim at open and multimodal solutions, avoiding fixed rules, and supporting different forms of play (Kress 2010; van Leeuwen 2005).

Paper 4. Marchetti 2013

Paper 4 presents data from the conclusive evaluations of the final prototype of MicroCulture conducted in the Danish museum. The theoretical framework of this paper builds on Rogoff (1990) and Dysthe et al. (2012).

The paper reflects on the role of technologies within museum learning practice, proposing that technologies could contribute to the on-going shift from the modernist to the postmodern paradigm, introducing a playful learning culture. This paper also discusses the results gained from the test of MicroCulture, focusing on how the new technology affected guided tours with respect to learning and the social interaction emerging between children and guides.

This social interaction is analysed through ethnographic observations and interaction analysis applied to video recordings (Jordan and Henderson 1995). The analysis focused on how the participants developed their play and how they communicated with each other while discussing the historical meaning of MicroCulture. The paper concludes that play contributed to shifting from a teacher-centered to a student-centered paradigm, promoting active participation of the learners.

1.4.3 Paper 5. Technology and museum innovation, implications.

Paper 5. Marchetti and Valente 2013.

The last paper presented in this thesis (Paper 5) proposes a reflection about the benefits digital technologies could bring to the process of museum innovation, connecting macro and micro level perspectives.

Empirical data came from the interviews conducted with the museum practitioners during the field study and the preliminary evaluations of MicroCulture. The theoretical framework of the paper builds on the notions of global network (Law and Callon 1992), boundary objects (Star and Griesemer 1989), and cultural capital (Bourdieu 1986).

In Paper 5, it is argued that museums should adopt off-the-shelf digital technologies, since the same hardware can be re-used in new configurations, running different software applications, and turning exhibition planning into an agile/user centred practice. In this scenario, digital technologies could play the role of boundary objects, allowing museums to establish a global network with external institutions, such as companies, research centres, universities, and schools. New forms of donation could be introduced, in which external institutions provide IT and/or pedagogical expertise in exchange for collaborations and eventually fiscal advantages. In conclusion, the museum could become the centre of a global network engaged in the creation of cooperations and content for new exhibits, which can be analysed as forms of cultural capital (Bourdieu 1986).

1.5 Structure of the thesis

This first chapter (Introduction) provides an overview of the problem domain, the adopted approach, goals, research questions, theory and methods, and expected results. In the end, the papers included in the thesis are presented; each of the selected papers addresses the research questions from different angles, covering the design of the MicroCulture and the formulation of the inclusive framework discussed in this thesis.

Chapter 2 presents the literature review on the research areas related to the topic of investigation: museum studies, interaction design, and guided tours.

Continuing further, chapter 3 discusses the theoretical foundations on which the empirical study and this thesis were built. Chapter 3 introduces the sociocultural theories about learning and human activities, which are adopted in the design-oriented research discussed in the thesis. Moreover, the chapter introduces theories about the nature of historical knowledge, which have inspired the design of MicroCulture as a tool to support learning of history.

Chapter 4 presents the methodological framework of the empirical study that builds on design-oriented research. In the end, the procedures followed for the empirical study are presented.

Chapter 5 discusses the results gained from the field study in order to define the requirements for the design of the new digital exhibit. This chapter focuses on interaction and learning aspects (micro level) and on organisational issues (macro level) from the perspective of the museums involved in the study.

Chapter 6 discusses the design process and the decisions involved in the creation of the prototype of the digital exhibit. This chapter also reports results from the workshops conducted with the children, the design concept, and its technical setup.

Finally, chapter 7 reflects on the contributions provided by the study, the included research papers, and the evaluation of MicroCulture. Each paper is discussed in relation to how it addresses the research questions and how it relates to the proposed inclusive framework.

2. Related Work: Digital technologies in museums

An extensive literature review has been conducted to gain an understanding of the factors that affect the digitisation of museum learning practice and an overview of the digital solutions that have already been proposed by researchers. This literature review is focused around three main research areas: museum studies, which include studies in the humanities addressing museum practice from different theoretical perspectives; interaction design studies addressing the creation and evaluation of interactive technologies for museums; and studies specifically focusing on the guided tours.

Analysing the literature in the three areas, I noticed that museum studies generally tend to focus on museum practice from an organisational and cultural perspective, investigating the role of museums within society as institutions and culture makers. On the other hand, interaction design studies often focus on evaluating how specific technologies affect the visitors during an exhibition. These two discourses are respectively called in this thesis macro and micro level discourses. Examples of museum studies dealing with the macro level discourse are for instance Janes (2009), Lang et al. (2006), and the more recent Roberts (2015), Mason (2015) and Hosker et al. (2014), which provide insights about the on-going changes affecting museum practice; wherein the last three studies discuss specifically the relations between museum oraganisational practice and design. These studies analyse how museums operate as organisations in relation to museum practitioners' competences and the introduction of management practices. At the same time, studies like Crowley and Jacobs (2002) and Falk (2013) discuss how visitors (more specifically families with children in Crowley and Jacobs 2002) approach the museum and the role of museums within society as learning contexts and culture makers. Furthermore Lischke et al. (2014) and Simon (2010) discuss how the museum can approach the visitors to innovate their curatorial practice.

The micro level discourse is generally represented in interaction design studies such as Hornecker (2008) and Hornecker and Stifter (2006), who conducted detailed observations of visitors engaging with digital exhibits in museums. Studies like Apostolellis and Bowman (2015), Danielak et al. (2014), or Muise and Wakkary (2010) also focus on the micro level discourse providing insights about how digital technologies could support learning and/or specific activities performed by visitors in museums. These activities might include school free or guided tours (Apostolellis and Bowman 2015) and family tours in museums (Muise and Wakkary 2010). Furthermore Muise and Wakkary (2010) and Danielak et al. (2014) specifically advocate for a constructivist or constructionist approach to facilitate learning inside the museum. All these studies focus on how specific instances of digital exhibits facilitated the visitors' engagement and access to knowledge. Another category of interaction design studies, represented for instance by Dindler and Iversen (2009) and Iversen and Smith (2012), Ciolfi (2012) or McCaw et al. (2014), as well as Hall and Bannon (2005), have a more methodological focus. In discussing the digital exhibits that the authors have created and their design process, these studies aim at showing how the adoption of participatory design methods can support the creation of digital exhibits and contribute to enrich young visitors' experience. According to my analysis, the interaction design studies here presented have the common goal of empowering visitors. For example, studies like Apostolellis and Bowman (2015), Danielak et al. (2014), Hornecker and Stifter (2006) and Muise and Wakkary (2010) investigate solutions that enable visitors to access knowledge on their own, without a specific order or facilitation. The interaction design studies conducted instead by Dindler and Iversen (2009), Iversen and Smith (2012), and Hall and Bannon (2005) aim at empowering young visitors by actively involving them in the development of technologies that should enrich their museum experience. While Ciolfi (2012) and McCaw et al. (2014) point out

that designers should take into considerations the limitations of actual practices conducted in museums and also the different competences represented by museum practitioners.

Museum studies typically focus on macro level discourse because their empirical data come from surveys conducted on an institutional level as it is the case of Hosker et al. (2014), Roberts (2015), Janes (2009) and Lang et al. (2006). An exception to this case is represented by the few studies dedicated to guided tours such as Best (2012) or Pierroux (2010), where the authors focus specifically on how guides and visitors interact with each other and the museum space. In this respect, Best (2012) sees opportunities in the introduction of digital technologies within guided tours in order to turn them into a more interactive practice; however, she also argues that because of the limited knowledge about guided tours, it is not clear how digital technologies could support that practice. One of the examples of museum studies about the role of digital technologies within museum learning practice is represented by Lang et al. (2006), who discusses how governmental investments, in the creation of webpages for museums, could support museums in knowledge dissemination, contributing in this way to the macro level discourse.

On the other hand, interaction design studies are said in this thesis to focus on micro level discourse, because their empirical data are usually taken from observations and interviews conducted with a group of visitors during the testing of digital exhibits (Apostolellis and Bowman 2015; Hornecker and Stifter 2006) or during the design process (Dindler and Iversen 2009; Iversen and Smith 2012; Ciolfi 2012). These studies consider only to a limited extent how the digital technologies can affect museum practitioners and contribute to museums as learning and culture making institutions, for instance Ciolfi (2012) argues that involvement of museums practitioners would bring benefit to the design process and the visitors' experience.

Hence, both museum and interaction design studies can be said to offer rather partial and complementary views of the complex changes affecting contemporary museum practice.

The categorisation of museum and interaction design studies into micro and macro level discourses emerged from my analysis of the literature and it is not explicitly discussed nor acknowledged in current research. I argue in this thesis that these two independent discourses have emerged and reflect a fragmentation in the study of the on-going shift in the role of museums. Moreover, I find that this fragmentation is affecting the introduction of digital technologies, as on one side, the interaction design studies discussed in this thesis provide good examples about how digital technologies can enrich visitors' experiences. However, since museum studies have investigated digital technologies to a little extent, it is not clear how these technologies can contribute to museum learning practice and its shift from an organisational perspective. This aspect is confirmed by the museum practitioners involved in my study, as discussed further in chapter 5.

A few research works implicitly combine both micro and macro level discourses. For instance, more comprehensive discussions on museum practice can be found in the GLLAM reports by Hooper-Greenhill et al. (2004, 2002, 2000) and in guided tours studies like Dysthe et al. (2012), Pierroux (2010), where empirical data about specific exhibitions or activities are used to reflect upon the role of museums within society and the on-going changes. Dysthe et al. (2012) discuss detailed qualitative data about how facilitation and dialogue emerge in museum learning practice reflecting at the same time on how an open dialogue between the museum and its visitors can contribute to the integration of young citizens into contemporary multi-ethnic society. Similarly Pierroux (2010) shows how specific ways of interaction between guides and visitors reflects the museums' adherence to specific learning traditions. Best (2012) represents another interesting study as she reflects upon her detailed inquiry on guided tours to claim that digital technologies could enrich guided tours providing more opportunities for interaction to young visitors. However, she has not investigated herself how digital technologies could contribute to guided tour practice. Finally the above-mentioned Ciolfi (2012) proposes an inclusive perspective for the

design of digital exhibits, meaning that museum practitioners should be involved in the design process, contributing with their own perspective and competences. At the same time Hosker et al. (2014) argue that museums will benefit from the active involvement of the different skills of practitioners, to create more accessible and flexible access to the collections from the public. Finally Roberts (2015) argues that the design of engaging and learning experiences inside the museum is in fact a distinct interdisciplinary field, which she calls interpretation design, combining knowledge from art, architecture, and communication. In my view these emergent claims for interdisciplinarity represent a step forward towards the creation of the inclusive framework proposed in this thesis, bridging the macro and micro level discourses.

This thesis aims, therefore, at continuing on the track defined by the studies of Hooper-Greenhill, Dysthe, Pierroux, Best, Roberts, and Ciolfi by expanding their scope from guided tours and learning to the digitisation of museum learning practice, hence re-conciling the current fragmentation between macro and micro level discourses.

The following sections present more in detail the mentioned related work: section 2.1 focuses on museum studies, section 2.2 discusses interaction design works, and section 2.3 studies about guided tours.

2.1 Museum studies (macro level)

Museum practice has recently entered a crisis (as discussed in Paper 1), caused by external pressure on museums to attract more visitors and of turning museums into more "effective" organisations (Fleming 2005). In this respect, two dominant themes have emerged, which I name in this thesis as:

1. Museum learning practice and the on-going shift(s);
2. Museums as context of culture.

The first theme is discussed in the sub-section immediately below and deals with issues related to the organisational aspect of museum practice in relation to attracting visitors (Roberts 2015; Janes 2009; Lang et al. 2006). The second theme is discussed in the next sub-section and deals with the role of museums within society as contexts for culture making and learning (Lischke et al. 2014; Simon 2010; Crowley and Jacobs 2002; Hooper-Greenhill et al. 2000).

2.1.1 Museum learning practice and the on-going shift or shift(s)

The first of the two themes that I will discuss from museum studies deals with museum learning practice and the on-going shift (or shifts) in the role of museums. According to Fleming (2005), the on-going shift affecting museums has already given positive results. Fleming argues that pressure applied on museums by politicians since the 1980's to "show us why we should maintain your funding" (Fleming 2005, p. 1) is pushing museums into becoming more effective organisations. Fleming actually claims that museums have to "maximise their effectiveness" (Fleming 2005, p. 3). Although he does not provide a definition of effectiveness, he afterwards explains that being "social constructs" museums have "to take their place in mainstream contemporary culture life" (Fleming 2005, p. 3) and cannot decide to be isolated and understood

only by a minority. As a result, Fleming claims that museums have become more effective in engaging with broader groups of visitors, accommodating to the needs of individuals with physical disabilities, or belonging to various ethnicities and age groups. A positive effect of this new attitude is also the emergence of a new approach towards communication practice. Communication was before perceived as a routine practice undertaken by museum practitioners aimed at notifying new exhibitions to the public (Fleming 2005). On the contrary, because of these shifts professional designers have been hired to create iconic graphic works and web pages for museums (Fleming 2005). The hiring of communication specialists is interpreted by Fleming as a sign that museums have started to think in terms of branding and communication, similarly to private companies.

Other studies focus on the question of the organisational shift in museums (Søndergaard and Janes 2012; Janes 2009; Lang et al. 2006) but depict a less bright picture. According to Lang et al. (2006), the improvements described by Fleming (2005) would be desirable, but have not been achieved yet. Lang et al. (2006) claim that the on-going shift is problematic, especially for museums placed in the UK, where the pressure of "diminishing or stand still budgets," combined with the demand from external institutions to deliver higher quality services, has created a need for museums to become more effective in thinking as private organisations increasing their income from different sources, such as: shops, cafés, social, and educational arrangements (Lang et al. 2006, p. 8). As a result, museums are pressured to face an organisational shift, thinking more as companies than as educational institutions. Similarly to Janes (2009), Lang et al. (2006) links the term "effective" to a requirement for museums to think as companies, in the way they manage their resources. At the same time Fleming (2005) and Reeve and Woollard (2006) link museums' effectiveness to the ability of museums in engaging with broader groups of visitors despite financial cuts. Hence, these authors talk about the need of improving "public accessibility of culture through price, location, and education" (Reeve and Woollard 2006, p. 7). A similar perspective can be found in Janes, who argues that there has been a paradigmatic shift in museums, from "collection-driven institutions to visitors-centred museums" (Janes 2009, p. 84-85). Moreover, marketing practice has been introduced into museums, such as branding and communication, as argued by Fleming (2005), with the goal of promoting new ideas and communicating to the public about the relevance of museums within society. According to Fleming, these new marketing strategies are a positive result of the shift in the role of museums, showing that museums have actually started to think more as companies.

But museum practitioners are neither marketers nor entrepreneurs. According to Janes (2009) and Lang et al. (2006), museum practitioners see themselves as culture makers and educators; this was also pointed out during interviews in Coventry. Hence, museum practitioners might perceive the demands of effectiveness as diverting energies from the activities they should prioritise: education and exhibition planning (Janes 2009; Lang et al. 2006). In this respect, Fleming also adds that the shift has turned museums into "institutions, which are not entirely dominated by a socio-economic elite, primarily male in character" (Fleming 2005, p. 1), opening up to professionals with different backgrounds. Fleming points positively at the fact that museums are attracting professionals from different fields and this trend has continued in the past 10 years as discussed in more recent studies. For instance Hosker et al. (2014) present two cases of interdisciplinary or cross-sectorial cooperation in the management of the archives of the museums affiliated to the University of Edinburgh. In the discussed cases experts in the field of curatorship, project management and system development employed at the university cooperated in creating a new platform for the digital archives of the Musical Instrument Museum and The Special Collections department that manages rare and antique manuscripts. This cooperation is defined as a "culture shift" (Hosker et al. 2014, p. 63), in which the staff was restructured into four new sections and opportunities for cross-sectorial cooperation became more visible. For instance a vision emerged for a new service linking different archives and enabling the public to

access different collections. The team used free, open source software named *ArchivesSpace*[4] to create their new interconnected archives. As a result the system provided support for cross collection search facilities and for retrieval of stored for pan-European projects. This study shows how cross-sectorial or interdisciplinary cooperation internal to museal organisations can enable practitioners in seeing new opportunities in meeting the needs of the public. At the same time, I see this internal cooperation as potentially contributing to the on-going shift in the role of museums, towards a culture of openness within and outside the organisation. In this respect this study is contributing to prepare the grounding for bridging micro and macro level discourses.

The studies conducted by Roberts (2015) and Mason (2015) follow a similar track discussing cooperation between external designers and museum practitioners. Roberts (2015) investigates the factors affecting the role of designers in a specific field, which she calls "interpretation design" (Roberts 2015, p. 379). According to Roberts interpretation design is an interdisciplinary field, which builds on "art, architecture and communication" (Roberts 2015, p. 379) and it is also informed by theories in education and museum studies. The field of interpretation design is concerned with the creation of engaging visitors' experiences "that contribute to learning and meaning-making while connecting visitors with a particular resource that may consist of a collection, story or site" (Roberts 2015, p. 380). Roberts also claims that interpretation design is little studied and that previously only museum practitioners engaged in interpretation design, but that in recent years it became more a collaboration with professional designers, where in some institutions designers are hired by the museums as permanent staff while in other cases the designers work as external consultants. The designer, either as an employee of the museum or as an external consultant, is according to Roberts (2015) a necessary counterpart representing competences museum practitioners might not have. Starting on an empirical work conducted in Australia, Roberts analyses four factors that might affect or limit the role of designers in interpretation design projects, such as: timing, client experience and attitude, project structure, understanding audience. According to Roberts designers are involved late in interpretation design projects, as the work of architects and curators is prioritised while designers' knowledge of visitors' experience is seen as "icing on the cake" (Roberts 2015, p. 383), pure aesthetics that can be added later. As a result designers might have to deal with already made decisions and limited freedom. The second factor affecting the designer's role is client's experience and attitude towards design practice. According to Roberts the client's lack of experience in handling the design process can cause additional pressure to the designers. In such cases the client might not be informed about the necessary documentation or about how design processes are conducted. In such cases the designers might have to work with insufficient documentation or they might have to take charge of the design process and eventually of educating the client to secure good results. The project structure can also affect the designer's role, especially when projects involve a heterogeneous group of external practitioners and separate contracts. This in turn affects the timing factor, so that the designer might be involved in the process "long after the architectural component is completed" (Roberts 2015, p. 386) limiting potential collaborations between designers and other practitioners. The last factor affecting the role of designers in interpretation design is the understanding of audiences. According to Roberts, since visitors are often absent from the design process, designers could be in charge of representing the needs of the audiences based on their experience. The designers interviewed in Roberts' studies expressed frustration for the lack of investigations into "audience characteristics and interests" (Roberts 2015, p. 387) by the museum institutions, leading towards ineffective exhibitions. Moreover, Roberts claim that prototyping practice should be involved in iterative design and evaluation processes, so that newly displayed exhibitions could be improved based on the feedback received from the visitors, as according to user centred design practice (Preece et al. 2011). The study discussed by Roberts

[4] http://archivesspace.org/ last seen on the 4th of February 2016.

provides an interdisciplinary perspective on the design of digital exhibits. However, I find problematic that Roberts present the designers as experts about the visitors, while the knowledge of guides might be overlooked. As argued in Woollard (2006), guides and educators spend a high amount of time in direct contact with the visitors; hence they might possess in-depth knowledge about how different groups of visitors relate to the exhibition. Moreover, the name interpretation design is also problematic, because the terms "interpretation" and "design" do not relate specifically to museum experience and any kind of design practice (no matter if it is product of graphic design) implies a certain degree of interpretation. Finally the term interpretation is ambiguous, as it does not clarify if it is the designer who should interpret the visitors' needs, or if it is the visitors who should interpret an exhibit arranged by the designer.

Mason (2014) analyses in detail the role of prototypes, in facilitating the cooperation between designers and museum practitioners in the creation of digital exhibits. His discussion is based on data gathered through five case studies using grounded theory on interviews and on the analysis of publications of the museums involved. Prototypes are seen as resources for knowledge sharing among professionals with different background, retaining information over time, integrating expertise from different voices, and learning by doing, as through the design process museum practitioners become more aware of the design of "the digital new exhibit the interface layout and information structure, and of how visitors would have interacted with the content" (Mason 2015, p. 412). According to Mason prototypes can make a significant contribution to the design of digital exhibits, in this respect both museum practitioners and designers should engage in the design process and prototypes should be shared in order to foster mutual understanding and creative thinking across different disciplines. The use of prototypes that Mason envisions in his study is not new to the design and business community, where researchers have investigated the use of prototypes in supporting interdisciplinary teams, as for instance in Preece et al. (2011) or Levina (2005), who leverages on the notion of boundary objects (Star and Griesemer 1989) to analyse how prototypes and visuals support interdisciplinary teams engaged in the development of interactive systems. However, Mason's contribution is meaningful with respect to the field of museum studies and the understanding of the on-going shift.

These two more recent studies imply that the cooperation between museums practitioners and designers is an existing practice, which according to Roberts needs to be formalized and identified with a specific name (interpretation design). At the same time Mason discusses how sharing of prototypes should be acknowledged as a key element in the design of digital exhibits. These works are seen in this thesis as interesting developments in museum studies, especially because at the time in which the empirical study discussed in this thesis was conducted, the design of digital exhibits was not a central topic in museum studies. Moreover, these studies show how an interdisciplinary grounding is needed to understand and support the shift in the role of museums and its digitisation. Interdisciplinarity is in fact seen both as a requirement in cooperation inside the organization among experts in different fields (Hosker et al. 2014) and outside among museum practitioners and external designers (Mason 2015; Roberts 2015). In my thesis, instead, I see interdisciplinarity as a requirement for the designer's work, which should represent the needs of the practitioners and visitors involved; this argument will be further developed in the following chapters of this thesis.

However, according to other researchers (Janes 2009; Woollard 2006), this openness towards different disciplines has posed challenges to the professional identity of museum educators and their role within museum learning practice represents a complex phenomenon having positive and negative effects. The general term of museum "educator" is used in the UK to indicate the museum practitioners who are engaged in the ideation and coordination of museum learning activities (Woollard 2006, p. 215). Museum educators do not come from the same theoretical backgrounds and different understandings can be found regarding the purpose and approaches of museum learning practice (Janes 2009; Woollard 2006). The existence of different

understandings of museum learning practice have positive implications from a visitors' perspective, as various activities can be proposed appealing to different groups. On the other hand, this means that museums cannot expect to hire educators with uniform experiences and a coherent understanding of the role of technologies within museum learning practice. Moreover, it has been argued that educators have an inferior status in comparison to other museum practitioners (Woollard 2006). According to Woollard, this apparently happens because educators enter in direct contact with visitors and go through a significant amount of self-training during the job (Woollard 2006). Moreover, Reeve (2006) argues that the majority of British museums employ trained volunteers who come from other professions and have taken short courses in order to perform guided tours. As a result, in some contexts, educators are not seen as real professionals, hence although educators might have a privileged understanding of visitors' needs, these practitioners are not involved in taking decisions about exhibition planning or about the future of museums' practice (Woollard 2006). This is acknowledged in a more recent study conducted by Ciolfi, who claims that educators "get little representation in curatorial practice" (Ciolfi 2012, p. 79). However, Ciolfi argues that educators and guides play a special role in bringing exhibitions up to life for the visitors, for this reason Ciolfi involved educators in her own design process while developing a new exhibit for the Hunt Museum in Limerick, Ireland[5]. According to Woollard (2006), museums and related organisations, such as The Museum Libraries and Archives Council, have attempted to formalise the competences required of museum educators, with the result of eliciting critiques and debates about the access to the profession. The current approach adopted by museums and galleries is to facilitate continuing professional development, collaborative programmes, visiting fellowships, and vocational awards that acknowledge actual competences (Woollard 2006). Furthermore, Allen and Crowley (2013) argue that educators can be a key part of learning experience and that their understanding of learning can affect visitors' experience and learning. According to the two authors educators have to face a challenge dealing with two learning metaphors: the acquisition metaphor, wherein knowledge is transmitted to the learners, and the participation metaphor, wherein knowledge is conceptualised through an active process (Allen and Crowley 2013). The two authors also argue that museums as well as schools are currently shifting from the acquisition to the participation metaphor, hence in support of their argument they report results on four cases in which museum educators reflected on their ways of dealing with visitors (Allen and Crowley 2013). As a result it turned out that educators have all slightly different understandings of their role and have developed different strategies to engage with visitors. One educator would adopt an inquiry format, while another would insist on the availability of tools or methods. In general the authors conclude that educators need a community of practice and shared professional vocabulary and pedagogy that "acknowledges and capitalises on the unique affordances of learning in informal settings" (Allen and Crowley 2013, p. 101). Similarly Moore (2015) has identified a challenge for educators in adapting to the adoption of digital and virtual learning technologies. This according to Moore (2015) has translated into needs for new competences, enabling educators to deal with new demographic groups, the increasing range of multimedia content, and interaction affordances for in person and online interaction.

Building on these studies educators and guides emerge as key participants in museum learning practice, but also as potential informants about museums' as well visitors' needs. Moreover, museum educators' competences should be carefully considered in relation to the digitisation of museum learning practice (Janes 2009), because their competences might affect the acquisition of digital technologies in museums and the definition of a coherent scenario for the role of the same technologies in museum learning practice, as discussed further in chapter 6 and paper 4.

[5] The study conducted by Ciolfi (2012) is discussed further in the sub-chapter 2.2.2.

2.1.2 Museums as contexts of culture

The second theme that I discuss from literature in the field of museum studies deals with museums as contexts of culture.

Since their creation in the Hellenistic time and until recent times, museums have been seen as sacred places, dedicated to the selection and preservation of precious objects from different times and cultures (Graves-Brown 2002). This means that traditionally, museums focused on selecting and preserving ancient objects and not on attracting visitors. In this respect, museums and the relevance of their practice as cultural institutions is being questioned, in relation to what museums have to offer to individual visitors and to the whole society (Søndergaard and Janes 2012; Janes 2009; Reeve 2006). Generally museum practice is associated with the display of notable objects, such as human artefacts or biological specimens, which are supposed to attract visitors to the museum (Graves-Brown 2002). Moreover, studies like Star and Griesemer (1989) argue that the objects displayed by museums act as boundary objects, enabling forms of mediated communication between visitors and museums. These objects are means of "translation" (Star and Griesemer 1989, p. 396), in the sense that they create space for communication and mutual understanding among individuals with different backgrounds. According to Star and Griesemer, the "creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds" (Star and Griesemer 1989, p. 393). This is because boundary objects are robust and flexible enough to enable individuals with different sociocultural backgrounds to engage in shared thinking and challenge each other's understanding.

In my view this account of the role of objects in museum practice reflects what happens during guided tours, in which individuals with different backgrounds and understandings of history meet and communicate with each other. I argue that new technologies developed for museum learning practice constitute a new category of boundary objects. In this regard, questions arise in relation to how a new digital exhibit fits within the need of museums to clarify its relevance to the surrounding society and to facilitate learning for individual participants.

The studies conducted by Crowley and Jacobs (2002) recognise a central value to museum artefacts, yet their studies challenge the relevance of museums as learning environments for young visitors, contributing to the understanding of the role of museums within society from a macro level perspective but building on data that come from a micro level analysis. In this respect, the contribution of Crowley and Jacobs is in line with Hooper-Greenhill et al. (2004), which combines micro and macro level discussions.

Crowley and Jacobs (2002) have observed children visiting natural history museums with their parents and have analysed their conversations. Afterwards, the authors evaluated the children's learning asking them questions about the specimens they saw with their parents. According to the two authors, children who have an interest for a specific subject acquire knowledge on an independent basis, so that when they reach the museum they use it as a performative stage to show how much they know in front of their parents. In one case, a boy and his mother approach a specimen, and as the mother appears in doubt about what it is in the attempt to tell her boy, the boy is happy to identify the specimen as eggs. The mother still in doubt checks the sign and in seeing that the boy is right, she shifts her tone of voice from teacher to learner, praising her boy (Crowley and Jacobs 2002). On the contrary, children who do not have any interest in museum-related subjects did not show to have gained significant new knowledge during their visit nor do they show interest in gaining new knowledge. In conclusion, the authors show a causal correlation between parents' mediation and the children who could identify more specimens in the late part of the study; however, this correlation is not found to be conclusive (Crowley and Jacobs 2002). The authors, therefore, propose a critical perspective regarding the educational value of museum visits, but at the same time, they claim that museums have a central role in

enabling children to see by themselves the specimens they have read about in books or talked about with parents. Moreover, as going to the museum is a unique, infrequent experience, the authors argue that being in the museum can support children in remembering what they saw, by adding a special gloss to the experience of seeing the exhibitions (Crowley and Jacobs 2002). In relation to the scope of this thesis, it is not clear from the study of Crowley and Jacobs how the learning activities offered by museums, such as guided tours or workshops, affect the children. In the perspective of Crowley and Jacobs, museum exhibitions play the role of boundary objects enabling children to get in contact with real objects from the past, have a unique experience, and eventually gain pride from their knowledge. In this respect, the translation of meaning taking place in museum practice allows for a playful reversal of roles and authorities, in terms of Sutton-Smith (1997), creating conditions for children to play the teachers with their parents. However, in the case of children who do not have specific knowledge prior to their access to the museum, the objects displayed are addressed in conversations, but not investigated in depth. As a consequence, these children are gaining control on their museum experience deciding which objects to look at. From a design perspective, Crowley and Jacobs indirectly suggest that museums could be also regarded as a performative arena, creating rewarding learning practices where children could show what they know and feel proud about themselves.

In line with Crowley and Jacobs, Falk (2013) has looked into the motivations that bring visitors to the museum. The work conducted by Falk is of particular relevance for this thesis as the practitioners based in Ribe (curator and museologist) consider Falk as a useful academic reference for their work. Falk conducted a series of in-depth interviews aimed at achieving a "more robust way to describe and understand the museum visitors' experience" (Falk 2013, p. 111). As a result, he found a link between motivation and visitors' identity, so that visitors talked about their museum visit in relation to whom "they thought they were or wanted to be" (Falk 2013, p. 112). By identity, Falk intends a continually constructed entity composed by internal and external social forces, cultural, and individual agencies. According to Falk, visitors' identity influences their understanding of their museum visit and of the advantages that this visit will bring to them. Falk identifies five main identities of museum visitors: explorers, facilitators, professional/hobbyists, experience seekers, and rechargers (Falk 2013). Each of these visitors provided different reasons for going to the museum. Explorers are driven by curiosity and an interest in the content of exhibitions. Facilitators instead visit museums to enable learning experiences for others, for instance their friends or their children. Professional/hobbyists are motivated by a specific interest in the museum content. It has been argued that traditionally, museums address this third category of visitors (Reeve and Woollard 2006; Fleming 2005). Experience seekers go to the museum because it is an important place to be. Rechargers look for a contemplative experience and are driven from spiritual and religious values. In conclusion, Falk argues that knowing visitors' motivations allows museums to gain insights about how visitors behave and interact with the setting. Moreover, the notion that visitors have different motivation might drive practitioners to look at visitors as individuals abandoning a "one-size-fits-all perspective" (Falk 2013, p. 121). Even though Falk bases his results on in-depth interviews with visitors, his work contributes to macro level discourse in relation to what the museum has to offer to its visitors.

In this respect, Simon (2010) argues that visitors are "deserting" museums and that museal institutions could regain their audiences, engaging with them "as cultural participants and not as passive consumers" (Simon 2010, chapter 1). Her book entitled the *Participatory Museum* proposes different techniques that museums could adopt to involve visitors in curatorial activities and to create more meaningful experiences for visitors (Simon 2010). Simon envisions a scenario in which museums act as platforms, connecting different users who play the role of "content creators, distributors, consumers, critics, and collaborators" (Simon 2010, chapter 1). A central notion in Simon's book is that of "social objects", which she defines as any objects displayed in a

museum, which might "naturally facilitate social experiences" among the visitors (Simon 2010, chapter 4). A social object could for instance be "an old stove that triggers visitors to share memories of their grandmother's kitchen, or an interactive building station that encourages people to play cooperatively" or even "a train whistle calling visitors to join the ride, or an educational program that asks them to team up and compete" (Simon 2010, chapter 4). According to Simon social objects can be defined with four qualities, according to the experience that these might trigger in the visitors. For instance social objects can be *personal* when people have a special connection to them, *active* when the objects can work as "shared reference points for discussion" (Simon 2010, chapter 4). Social objects can also be *provocative* when the objects do not need to physically enter the social environment to become a topic of discussion, and finally *relational*, when they explicitly require more individuals to be activated, hence clearly calling for cooperation (Simon 2010, chapter 4).

So defined the use of social objects can trigger social interaction among visitors, also strangers who happen to be at the same exhibitions, turning a traditional, static exhibition into a more active, participatory experience. Simon's notion of social objects shares similarities with the notion of boundary objects discussed by Star and Griesemer (1989). As discussed previously in this chapter, boundary objects are defined as means of translation, facilitating communication and mutual understanding among individuals belonging to different backgrounds, such as professional scientists specialised in various fields and also among museum practitioners and visitors. Furthermore, according to Simon (2010) museums have to develop their own model for participation, deciding on how they intend to manage visitors' involvement, in terms of trust in the visitors' ability and responsiveness to their contribution (Simon 2010, chapter 5). Starting from this model, museums practitioners should engage in participatory projects with the visitors in order to give voice to the needs and interests of the local community, "to provide a place for community engagement and dialogue," and to "help participants develop skills that will support their own individual and community goals" (Simon 2010, chapter 5). This study suggests museums to adopt a more open approach in curatorial practice. Simon in fact sees museums as platforms connecting different individuals involved in museum practice and in the local communities. I consider this approach as a needed step towards bridging micro and macro level discourse, as discussed further in Paper 5 and chapter 7.

Following a similar track, Lischke et al. (2014) discuss how museums could share curatorial practice with the visitors. The solution they propose is called *Parallel Exhibits* and it bridges the two scenarios propose by Simon, as it enables visitors to create virtual exhibitions combining exhibited as well as non-exhibited artefacts (Lischke et al. 2014). The authors' aim is twofold: to provide visitors with access to artefacts that are part of the museum's collection but are not displayed, as it often happens, and to enable visitors to participate in curatorial practice. The outcome is a system that gives access to the visitors to see all the objects of the collection through digital archives and to compose their own personalised exhibitions, both in situ and online. The authors envision three main scenarios for Parallel Exhibits, in the first scenario visitors "are acting as curators" inside the museum and their newly created exhibitions can be used as resources for curators to get insights of visitors' interests (Lischke et al. 2014, p. 155). In this scenario Parallel Exhibits is seen also as a resource to turn museums into more interactive contexts. In the second scenario visitors could use Parallel Exhibits online on the museum's webpage, to facilitate "a deeper interaction with the community of the museum" so that "interested and enthusiastic volunteers can contribute with their knowledge" (Lischke et al. 2014, p. 156), and also to prepare future visitors for their museum tour. In the final scenario museum professionals could use Parallel Exhibits to "sketch arrangements for new exhibitions" (Lischke et al. 2014, p. 156). The system should enable museum practitioners to explore and visualise different arrangements without much use of time and resources. According to the authors, these

visualisations could support a participatory curatorial practice, involving visitors or staff from other museums.

I find these two studies (Lischke et al. 2014; Simon 2010) relevant for my thesis as they both represent the perspective of the museum as an organisation that needs to open up towards participation of visitors in curatorial practice. In the scenario proposed by Simon museum practitioners and visitors collaborate during the design process. Instead the scenario of Lischke et al. (2014) proposes to facilitate visitors' participation in curatorial practice during their museum visits, interacting with already finished exhibits. In both cases, however, exhibitions are discussed as open to constant changes, either through direct participation to iterative evaluation and re-design processes, or through remote participation facilitated by online access to the collections and social media.

The numerous studies conducted by Hooper-Greenhill et al. (2004; 2002; 2000) have investigated the relevance of museum practice from a macro level organisational perspective, focusing on how museums meet government expectations in relation to learning and other sociocultural issues. According to the Group for Large Local Authority Museum (GLLAM) report from 2000, museums are organising initiatives to deal with the issue of social inclusion (Hooper-Greenhill et al. 2000). For example, the political statements expressed by the curator of the Tyne and Wear Museum of Dundee (Scotland) are compared with the goals declared by the Dundee City Council (Hooper-Greenhill et al. 2000). Distinctive similarities are identified by the authors, such as a common interest in promoting social inclusion and active citizenship through education. However, scepticism is expressed regarding the achievement of these goals, from the side of museums as well as city council. The authors of the report argue in fact that the discussed statements or goals are powerful tools of change, which can be effective only if the editors of such statements or goals have the needed degree of authority to turn them into action (Hooper Greenhill et al. 2000). Hooper-Greenhill's report contributes mainly to the macro level discourse about the shift in the role of museums, as it allows gaining a glimpse on the relationship of museums with other organisations involved in the shift. This report also suggests that the relevance of museums for society could be to contribute to social inclusion and the emergence of active citizenship, intended as the formation of young citizens conscious of their cultural heritage and able to participate in the life of their community.

Similarly, a later GLLAM report from 2004 discusses a complex quantitative evaluation on the impact of the Renaissance in the Regions Education Programme from the perspective of primary schools pupils and teachers (Hooper-Greenhill et al. 2004). This report represents one of the few examples of literature combining macro and micro level discourses in analysing museum learning practice. The programme aimed at the creation of an "integrated framework for the museum sector, based on a network of museums grouped into regional Hubs" to promote "the development and improvement of the learning and education potential of museums" (Hooper-Greenhill et al. 2004, p. II). The focus of the report is on teachers' and pupils' perception of the programme learning outcomes, to prove that museums are successful in inspiring learning and eliciting confidence and motivation in the pupils, according to government targets (Hooper-Greenhill et al. 2004). In this respect, Hooper-Greenhill et al. are advocating museum work, confirming that the process of museum's organisational and technological shift is troublesome and has implications for museum learning practice with respect to gaining and managing financial resources, justifying their decisions with external institutions, and the crisis of museum professional identity. This perspective is discussed also by Fleming (2005), who claims that the GLLAM reports were aimed at praising the work of museums and at reinforcing their position to the eyes of political authorities.

Summing up, the value of museums as learning contexts is uncertain when it is not clear to which

extent museums are contributing to the knowledge of individual visitors (Crowley and Jacobs 2002) and also what museums have to offer to young visitors as future citizens (Hooper-Greenhill et al. 2004, 2000). These studies also reveal different sociocultural-political stands on museums, some propose critical perspectives like Crowley and Jacobs (2002) while others like Hooper-Greenhill et al. (2002, 2004) defend museum learning practice emphasising similarities of objectives between government and museums and the effectiveness of museums' initiatives in achieving these objectives. At the same time Simon (2010) and Lischke et al. (2014) advocate for turning curatorial practice into a participatory practice, to which visitors could actively contribute. In conclusion, I find these studies meaningful as they contribute to the identification of the sociocultural factors that affect museum practice, such as: the physical environment of museums and their collections seen as boundary objects, the focus on learning and education of young citizens, the various attitudes of visitors, the eventual involvement of visitors within curatorial practice, and the complex relationship between museums and political authorities. At the same time, these studies could suggest that the on-going shift is troublesome; they reveal in various ways that there is a need to justify the existence of museums and to defend their values for society.

2.2 Interaction Design (micro level)

The field of interaction design targeted at the museum context is broad and embraces different kinds of studies. The works discussed in this thesis have the goal of enriching visitors' experience through engaging digital exhibits (Lyons et al. 2015; Hornecker and Stifter 2006) and of promoting the adoption of participatory design methods and of interdisciplinary perspectives to innovate museum practice according to young visitors' needs (Ciolfi 2012; Iversen and Smith 2012; Dindler and Iversen 2009).

Two main themes emerge from my analysis of current literature, which I call with the terms: engagement and empowerment. The terms "engagement" and "to engage" are mentioned and discussed by several authors. For instance engagement can be discussed in relation to "cognitive engagement" and learning (Apostolellis and Bowman 2015, p. 167), but also in relation to eliciting "positive feelings" (Apostolellis and Bowman 2015, p. 168). Similar discussions can be found in relation to the fostering of playful interaction to facilitate visitors' independent access of information and learning supporting visitors' emergent activities (Lyons et al. 2015; Muratsu et al. 2014; Muise and Wakkary 2010; Hornecker 2008). Several interaction design studies also aim at granting visitors opportunities of self-expression (Apostolellis and Bowman 2015; Lischke et al. 2015; Hornecker 2008; Hall and Bannon 2005). Other studies take instead a methodological perspective on the design of new digital exhibits, arguing that visitors should actively contribute to the creation of a new digital exhibit through participatory design workshops involving different practitioners in interdisciplinary collaborations (Ciolfi 2012) and visitors (Lischke et al. 2015; Dindler and Iversen 2009).

I understand all these studies as sharing the theme of enabling visitors in making their own statement when accessing the exhibition or even in the making of new exhibits. Building on Druin (2002) and her understanding of participatory design, I use the term empowerment to define the emerging goal of these interaction design studies. According to Druin, children and adults can feel empowered when actively involved in the design process, as they feel that they "can have an impact on how technologies are 'changed'" (Druin 2002, p. 29). At the same time, I see the interaction design studies discussed in this thesis as having the common goal of enabling visitors to have more impact on their museum experience, either through opportunities for self-expression or through active involvement in the design of new digital exhibits.

The mentioned works mainly contribute to micro level discourse, focusing on the perspective of individual visitors on their museum experience and on the design of new exhibition settings to enhance such experience. Moreover, these works provided inspiration to the empirical study discussed in this thesis in terms of methodological guidelines, design requirements, and user experience. In the following sub-section, studies concerned with visitors' self-expression and playful interactions are discussed (2.2.1); methodological studies are presented in the sub-section after that (2.2.2).

2.2.1 Self-expression and playful interactions

Studies conducted by Hornecker (2008) and Hornecker and Stifter (2006), analyse digital exhibits from the perspective of user experience and emergent interaction. The goal of these studies is to make sense of visitors' experience and gain new design requirements to be applied to the design of new digital exhibits. Hornecker (2008) analysed users' responses to the *Tree of Life Table*, a large multi-touch surface table, displayed at the Natural History Museum in Berlin. This installation allows visitors to navigate through information about different animal species touching a series of popping-up bubbles. Ethnographic observations revealed that playful forms of interaction spontaneously emerged that were neither planned nor expected by the designers, such as tapping or caressing the surface with a flat palm, or with different movements of the fingers. Hornecker (2008) interpreted these different interactions as evidence that the installation supported self-expression and free access to information, hence, enabling visitors to have an impact on their museum experience.

Following a similar perspective, a complex quantitative analysis of the "medien.welten" interactive exhibition (Hornecker and Sifter 2006) provided rich insights regarding how people can experience museums digital exhibits. The exhibition was arranged by the Museum of Sciences in Vienna. It was targeted at visitors from different age groups and was aimed at eliciting interest and awareness about our media-based society (Hornecker and Stifter 2006). The exhibition was structured into three "thematic islands," showing from a diachronic, change-centred perspective the progression of media technology in the field of transmission, storage, and calculation media. The study ends reflecting on the observed users' responses and proposing a series of factors that should be taken into account in the design of new technologies for museums. For instance, it was observed that visitors were mostly affected by familiar artefacts that they have used in their everyday life. Elderly visitors expressed a nostalgic feeling for objects they used when they were young. Children instead were enthusiastic about the games displayed in the digital room (Hornecker and Stifter 2006). This seems to indicate that visitors are most affected by objects that relate to their everyday life or their past experiences. From the study, it also emerged that time is a central factor to take into consideration when designing digital exhibits, as some visitors have dedicated only a few seconds to each exhibit while others took long time to explore specific exhibits. On this basis, the two authors argue that museum digital exhibits should be enjoyable in short as well as in a long span of time. Furthermore, mixed reality and tangible exhibits that included a challenging task were the most popular. The two authors specifically refer to exhibits like the *Abacus* that combined a physical interface with digital media and a task, as it guided the visitors providing feedback and instructions through calculation examples. These kinds of exhibits attracted the most variety of visitors, afforded rich forms of social interaction, and elicited a feeling of reward when the visitors succeeded in solving the tasks (Hornecker and Stifter 2006). Finally, the two authors also observed that most visitors were families, couples, or groups of friends, but claim that this aspect is not taken into account in exhibition planning, which focuses on individual visitors (Hornecker and Stifter 2006). This study offers concrete examples and guidelines about which sociocultural factors to consider in the design of new digital

exhibits and to meet the visitors' needs in relation to: the visitors' personal experience, time, and group interaction. However, the authors observed the visitors freely exploring the museum space without any given structure or time frame. In this sense, it would be interesting to combine these results with observations of how visitors interact with technologies (and educators) during structured museums practices, such as guided tours or workshops.

Similar understandings regarding visitors' empowerment and engagement are central to the study conducted by Muise and Wakkary (2010), who designed a playful mobile system specifically aimed at enriching families' museum experience through shared problem solving. The design outcome is *Kurio*, a hybrid system composed by a set of tangibles, a tabletop display, and a personal digital assistant (PDA). The system was tested during the "BodyWorks 2" exhibit at Telus World of Science[6], in Edmonton, Canada. The visitors engaging with Kurio were supposed to play the role of time travellers, who have to gather information about their current time in order to repair their "time compass" and be able to come back to their own time (Muise and Wakkary 2010). The authors are inspired by constructivism, especially by the works of Piaget (1896–1980) and Vygotsky (1896-1934), whose theory is further discussed in chapter 3.

The study conducted by Danielak et al. (2014) builds on constructionism and aims at providing scaffolding knowledge to children about programming of electronic circuits. Constructionism is a pedagogical approach rooted on constructivism and the authors refer to the work of Papert and Harel (1991), expecting that learners gain new knowledge not only when they are engaged in the construction of their own knowledge "but also when they represent their knowledge in the form of externally accessible artifacts" (Danielak et al. 2014, p. 229). The solution they propose is defined as a "museum-based interactive tabletop computer game called *MakeScape Lite"* (Danielak et al. 2014, p. 229). The concept of MakeScape was tested through a prototype made for the iPad. The goal of MakeScape is to contribute to the children's "scientific and technological literacy" (Danielak et al. 2014, p. 229) in the context of museums, in line with recent educational policy in the US. The exhibit enables children to explore basic knowledge on electronics building and modifying virtual circuits in a fantasy world. The prototype was tested in a museums with "middle-school aged" visitors (Danielak et al. 2014, p. 229) and targeted at the activity of tinkering and exploration of technologies. According to the authors, results from the study show that emergent role play and social interaction among the visitors highly contributed to their learning process and enabled them to go on with the game. However, the study does not discuss in depth how MakeScape could contribute to museum experience or museum learning practice, nevertheless I find that the insights about the impact of role play and social interaction on learning are relevant for my own thesis.

Another study supporting learning about electronic circuits is the one discussed by Lyons et al. (2015). The researchers propose a multi-touch table exhibit designed to support the activity of "tinkering" in electronics, defined as a "disciplinary practice": a common way in which experts of a specific field act when solving a problem (Lyons et al. 2015, p. 49). Interestingly the authors of this study argue that designers must decide which activity they want to support, evaluating "how best to align the affordances of these resources with the learning activities they are trying to support" (Lyons et al. 2015, p. 49). Moreover, Lyons et al. also refer to constructivism, as a valid approach to facilitate tinkering and hands-on experiences, as it is common in science museums. According to the authors, when learners are tinkering, they engage in an iterative process, in which "just in time resources and feedback" provide guidance in "fixing a constructed artefact and in exploring the problem space" (Lyons et al. 2015, p. 49). Therefore, the authors identify as a key aspect of their investigation to explore how to make engineering knowledge visible to the visitors through the interface elements and feedback. The outcome discussed by the authors is a

[6] http://www.edmontonscience.com/ (last visited spring 2013).

digital exhibit called *Oztoc*. Players are supposed to play the role of electrical engineers in charge of creating glowing fishing lures, to help fictional scientists to capture and study a new species of bioluminescent fish (Lyons et al. 2015). The visitors are supposed to build simple circuits on the table with wooden blocks, representing different electrical components. The exhibit is aimed at supporting tinkering providing visual cues to the visitors about: "(a) the materials at hand to build a solution to the problem, (b) processes for employing those materials, (c) the current "state" of development of the solution-in-progress, and (d) the degree to which the current solution satisfies the problem" (Lyons et al. 2015, p. 53). A test was conducted at a major science museum with 152 visitors. The researchers were present and recorded the visitors' interaction for later analysis, not to intrude in the visitors' experience. Results from the testing show that in general the exhibit was well received, however, the players performed in different ways when having to interpret the given clues. In some cases the visitors explored only 2 or 3 different solutions, while the researchers expected the visitors to be more immersed in their tinkering process and to explore more possibilities. I find that this study provides valuable insights in relation to the design of digital exhibits. For instance in claiming that designers should contextualise their process within precise activities, the authors contribute in creating a grounding for designers to look at specific learning practices offered by museums, like guided tours and workshops. Moreover, in selecting specific activities designers can contextualise the formulation of design requirements, in relation to how visitors' engage with the specific activity and its goals, path of actions, and available resources. Finally it is interesting to consider how several studies, such as Muise and Wakkary (2010), Danielak et al. (2014), and Lyons et al. (2015) take constructivism or constructionism as their theoretical grounding, to contribute to informal learning in museums through hands-on, playful experiences. These theories can in fact be seen as particularly relevant as they discuss learning as a social process involving forms of tangible interactions. In this respect I find these studies as valuable sources of inspiration and reflection for my own thesis.

Similarly to Lyons et al. (2015), also other interaction design studies address learning activities of visitors inside the museum, such as Roberts et al. (2014), Muratsu et al. (2014), and Apostolellis and Bowman (2015). The study conducted by Roberts et al. (2014) is aimed at supporting visitors in making sense of visualisation of complex data related to census in science museums. The study discusses the design of a digital exhibit called *CoCensus*, which leverages on role play, social interaction, and personalisation of data visualisation to enrich visitors' experience. The authors build on sociocultural learning theories, and more specifically on the work of Vygotsky (1987), claiming that: "concepts must be articulated in the social space before they can be truly incorporated into an individual's understanding" (Roberts et al. 2014, p. 8). For this reason the authors argue that museums are ideal contexts of collaborative forms of learning. Based on these premises, the CoCensus exhibit was designed to enable visitors to explore in collaborative ways data from the U.S. census, visualised on an interactive data map. The study also aims at providing visitors with multiple perspectives on the data, specifically: an "onlooker" perspective, defined as a third person, overview perspective; and an actor "perspective", defined as a first person and personalised perspective. In order to access the data through the actor perspective the users are supposed to create an avatar for themselves, which will act as a character in the system and will enable the users to see personalised data, related to their avatar, on a geographical map. The evaluation of the study was conducted inside a local science museum, where the visitors were invited to try the exhibit in a vertical and horizontal configuration, and from the actor and onlooker perspectives. The researchers found that that children engaging with CoCensus generally tended to compare the displayed data "over time or across the data set" (Roberts et al. 2014, p. 14). Moreover, it was observed that the actor perspective could better facilitate reasoning and sense making of the data as well as social interaction among the users. This study provides interesting insights in relation to my study, as it deals with the visualisation of complex data, which might change over time. Moreover, Roberts et al. reflect also on the visitors' perspective on the

data visualised in the exhibit. These are concerns that emerged also in my study, since I aim at visualising Viking Age's urban development as a process that takes place through time and role play.

The study conducted by Muratsu et al. (2014) takes a similar perspective, targeting children's scientific inquiry in museums, which is seen as an authentic scientific inquiry in which children have to "observe subjects and interpret the data they have obtained through observations" (Muratsu et al. 2014, p. 233). The authors propose an installation called *Stamp-On*, which facilitates children to conduct scientific inquiries during museum visits. Stamp-On is a stand-alone system, which runs on an iPad mini and with a stamp-shaped interface to be activated with a stylus. The system is supposed to facilitate children identifying objects displayed in a museum, avoiding misunderstandings, where the stamps link exhibits to content. The system was tested with 25 children between 11 and 12 years of age, and the children had to conduct an inquiry about eight types of rocks from the prefecture of Hyogo in Japan (Muratsu et al. 2014). During the test the children had to identify specific rocks, observing the rocks displayed in the museum and using hints about surface and colours, and a magnified image of the rock surface. In order to identify the rock in the system, the children had to press the stamp attached to the rock they have chosen against the "answer" button on the screen of the iPad mini. During the test the researchers observed the visitors and the behaviour of one participant was recorded. In the end the authors argue that the system was found to be useful in supporting children's learning. However, since only one visitor was recorded, doubts could be raised on the validity of the analysis that was conducted by the researchers. In general this study can be said to provide another example of how technologies could be integrated in the flow of children's museum experience and in encouraging an active engagement with the exhibition.

Finally the study discussed by Apostolellis and Bowman (2015) aims at providing scaffolding for young visitors learning about olives production called *C-OLiVE,* which stays for: Collaborative Orchestrated Learning in Virtual Environments. C-OLiVE reproduces an olive oil factory dated to the 1950s, located on the island of Lesvos, in Greece. The two authors build their study on the *Contextual Model of Learning* (Falk and Dierking 2000), according to which learning is affected by three contexts: "the personal, the social and physical" (Apostolellis and Bowman 2015, p. 161). Starting from these premises, the two authors aim at investigating how the three factors related to the personal context can affect learning in the museum with C-OLiVE. These factors are identified as: "motivation and expectations; prior knowledge, interests, and beliefs; choice and control, and the two factors of the sociocultural context (within-group sociocultural mediation; facilitated mediation by others)" (Apostolellis and Bowman 2015, p. 161). The new exhibit was evaluated through a quantitative, score-based assessment, however, the authors are critical towards their own approach claiming that it "largely ignores the rich type of learning happening in museums" (Apostolellis and Bowman 2015, p. 168). The authors leverage on principles from sociocultural theories such as peripheral participation and mediation by peers or experts and argue that more options should be offered to students visiting museums "for multi/cross-cultural online collaborative tools. At the same time the authors argue that museum learning practice does not include the rich social interaction opportunities afforded by co-located collaborative play" (Apostolellis and Bowman 2015, p. 161). In the paper they compare two studies. The first study was conducted with middle school students in a controlled environment in the US and it focused on evaluating how tripartite collaboration could improve learning. The second was instead conducted in Greece and focused on evaluating how expert guides could support children understanding the material presented in the game (Apostolellis and Bowman 2015). The authors found significant differences in the two studies, in particular in relation to how facilitation of an expert guide led to greater learning gains as compared to students playing alone (Apostolellis and Bowman 2015). According to the authors, the collected data suggest that the exhibit supported

different forms of interaction and group dynamics, but that guides can provide an essential contribution in fostering learning. The authors conclude their study with a series of five guidelines for the design of digital exhibits, such as: to enable simultaneous collaboration of visitors only when learners have been accustomed to discovery learning experiences. Adapt to individual student skills and preferences. Use scaffolding to alleviate the burden of working in a complex learning environment, especially for novice or less able students. Precede the game with some sort of structured activity. Follow the museum experience by some conclusive information presentation. (Apostolellis and Bowman 2015, p. 168). These guidelines have the goal to provide more meaningful scaffolding for learning in the museum space, through collaborative play. Two contributions from Apostolellis and Bowman emerge as particularly meaningful for my thesis: their use of sociocultural theory in detecting factors that affect learning in museums and the role of expert guides in facilitating learning. In this respect, I see the study of C-OLiVE as preparing the ground for my study, in which I build on sociocultural theory to explore how digital technologies could enrich the guided tour. Moreover, I aim at developing further their approach, analysing learning inside the museum from a sociocultural perspective, also taking into account the needs of museum practitioners, and including those practitioners (especially guides) in my design process.

The studies discussed in this sub-section refer to play as a resource to enrich visitors' experience from an individual and/or social perspective. Digital exhibits are presented in those studies as empowering visitors and enabling them to access knowledge in intrinsically motivated ways. Moreover, play can be intentionally introduced by designers through specific interventions (Lyons et al. 2015; Apostolellis and Bowman 2015; Muise and Wakkary 2010) or it can emerge in a spontaneous way when visitors engage with an interactive information kiosk (Hornecker 2008). The latest studies discussed in this section provide interesting additions, contributing to the discussion about empowerment and engagement, but also attempting to frame their design intervention in relation to visitors' activities as Muise and Wakkary did already in 2010. For instance Apostolellis and Bowman (2015) involve guides in the evaluation, while Roberts (2014) and Muratsu (2015) target respectively visitors' interpretation of meaning of exhibitions and scientific inquiry. However, these studies do not target museum learning practices, like for instance the guided tours, and history seems little investigated in comparison to scientific learning topics. In this sense, play emerges as a rich form of social interaction enriching visitors' experience of museums, no matter if it is prescribed or not. Starting from these insights, different possibilities could be explored in relation to the role of play in visitors' experience and in museum learning practice. The study discussed in this thesis explores specifically how play can enrich guided tours, contributing to learning of history and redefining the role of the individuals involved.

2.2.2 Methodological studies

Empowerment and engagement are also at the core of interaction design studies that focus on methodological discussions. In general these studies argue that young visitor should be involved in participatory design processes aimed at the creation of new digital exhibits, young visitors could have the chance of actively participate in enriching their own museum experience, according to key principles in participatory design (Druin 2002).

Mazzone et al. (2004) explored the role of "drawing interventions" made by children as a rich source of information and inspiration (Mazzone et al. 2004, p. 198). For instance drawing

interventions can be used to evaluate, together with the children, an activity they have just completed. The study of Mazzone is a short paper, however, it makes an interesting contribution discussing how children's drawings can be used as source of inspiration in a participatory design process or in testing.

The tabletop rune stones editor, created by Dindler and Iversen (2009) and displayed at Moesgaard museum in Aarhus (Denmark), was aimed at eliciting interest in the past bridging young visitors' everyday passion for digital games to museum experience. Young visitors were invited to participatory workshops so that they could contribute to the design of the interface and to the creation of a local map where the rune stones would be placed. Observations during the exhibition show that children living in the museum area were pleased to recognise their own neighbourhood on the map (Dindler and Iversen 2009). Moreover, the activity of editing rune stones provided opportunities for empowerment and self-expression, in the sense that the users became active contributors to the exhibition, as the created rune stones were saved in the system and could be seen by other visitors (Dindler and Iversen 2009). Some children dedicated their rune stones to family members or friends. For instance, a stone was dedicated to a girl for being pretty. In this way, the children rediscovered the actual function of rune stones during the Viking Age and could relate to them as something belonging to them, the geographical setting they live in and their perception of the people they know.

The same research team conducted a similar study about teenagers' museum experience (Dindler et al. 2010). A series of participatory workshops was run, where the participants were invited to design a new exhibition inspired by their favourite computer game. According to the authors, results suggest that most participants did not have personal interest for history, but this could be elicited if ancient artefacts and practices were retrieved from the past through parallels between the visitors' everyday life and the life of people of their own age in the past (Dindler et al. 2010). This study was followed up by the creation of the *Digital Natives Exhibition*, an interactive exhibition about the everyday life of the new generation of young people born in the digital era, as defined by Prensky (2001). This exhibition was displayed at the Aarhus Centre for Contemporary Art in December 2010 and it was created through an interdisciplinary, participatory collaboration involving a group of seven representatives of the digital natives generation and groups of anthropologists, architects and interaction designers. The two authors acknowledge a shift in the way heritage is being created and communicated in the museum context, so that the exhibition space has become a context for creating "dialogical experiences and connections between matters of heritage and audience's everyday lives" (Iversen and Smith 2012, p. 129). Starting from these premises, the authors explore the role of the museum as a "connector" and the role of social media in supporting online and user-generated content through "social networking, media sharing, social locative tagging, microblogging" (Iversen and Smith 2012, p. 129). In this respect the authors aimed at co-creating with digital natives an exhibition that could express their voices, but also at exploring how social media could alter the role of museums, in "transforming and enriching our understandings, perspectives and visions of the world as they relate to the past, present and future experience" (Iversen and Smith 2012, p. 126). The exhibition included four main digital exhibits named: *Google My Head*, *DJ Station*, *Portraits*, and *Digital Sea*. The Google My Head exhibit is an interactive tabletop installation enabling visitors to browse across a repository of online and mobile updates from digital natives on a multitouch screen. In order to browse the displayed material, the visitors have to complete the sentence "Digital Natives are…" choosing freely from four utterances, pictures or videos. The created sentences are stored in the system and can be seen by other visitors. According to Iversen and Smith (2012) this exhibit enabled visitors to engage with the fragmented information and communication characterising the life of digital natives through the creation of new emerging understandings of what does it mean to be a digital native. The second exhibit is called DJ Station and it uses tangible cubes with a fiducials tracking system, to enable the visitors to interact with

the musical universe of the seven digital natives involved in the project. Each of the cubes represents the musical universe of each of the participants and each face of the cubes is covered by a fiducial, which could play a musical loop when placed on the installation. Other coloured cubes contain audio effects, which could be applied to the musical loops. By interacting with the DJ Station the visitors act as DJs, playing and mixing musical loops and audio effects. The third exhibit is called Portraits, it is defined as an artistic video installation "inviting visitors to explore the passion of a girl for books" (Iversen and Smith 2012, p. 133). The system uses an infrared camera, enabling the visitors to control the selection of different clips, timing, speed, and coloring of the clips through the intensity of visitors' physical movements (Iversen and Smith 2012). According to the authors, the visitors were able to use the installation with minimal guidance, exploring the digital and visual practices of "production, reproduction and consumption in which young digital generation is engaged" (Iversen and Smith 2012, p. 134). The fourth and final exhibit is called Digital Sea and it is interconnected to the Google My Head exhibit. Digital Sea is an interactive floor-projection allowing visitors to explore digital materials from various media and mobile platforms, such as: Facebook updates, photos, SMS messages and videos linked to the Google My Head exhibit. These materials float randomly on the floor and the visitors can freely activate them through physical movements and a tracking system mounted on the ceiling. The chosen materials are enlarged on the floor and are surrounding the visitor, who made the selection. The aim of the exhibit is to enable the exploration of fragmented materials from various media, representing how the everyday life of digital natives is permeated by the use of heterogeneous social media (Iversen and Smith 2012). According to the authors, the four exhibits allowed for an in situ curatorial practice, as the visitors selected which material should be visualized for other visitors. In this way a dialogue among the visitors emerged as "performative acts", leveraging on kinesthetic interaction (Iversen and Smith 2012, p. 140). This dialogic form of curatorial practice leads towards open questions in relation to my own study. For instance it could be interesting to find out more about which understandings are elicited in the visitors about history, and how new technologies and understanding of these technologies lead towards changes in the way new generations see themselves in relation to the world around them. This discourse is in fact at the core of sociocultural understanding of history, which are represented in the works of notable historians like Le Goff (1990) and Huizinga (1937) as discussed further in chapter 3 (3.4).

Hall and Bannon (2005) followed a similar approach, as they investigated the use of ubiquitous computing environments in eliciting a playful museum experience. A group of children was involved in the design of a new interactive environment for the Hunt Museum in Limerick, Ireland. Ubiquitous computing was chosen as it allows hiding technology and emphasising the interaction element (Hall and Bannon 2005). The outcome was a playful exhibition of copies of the antiquities displayed inside the museum, which were enhanced with RFID and targeted at children play. For instance, the children could control Flash animations showed on a screen inside a trunk, by putting RFID cards on a reader also placed inside the trunk. In the end of the exhibition, the children could leave their feedback by interacting with a phone and listening to other visitors' feedback activating a radio (Hall and Bannon 2005).

This same study is discussed as a case in a later publication (Ciolfi 2012), which proposes to adopt a more "inclusive" perspective in the design of digital exhibits. This newer study implicitly acknowledges the on-going shift discussed in this thesis, saying that traditionally curatorial decisions were invisible and not open for discussion to the visitors, while recently museums and the creation of heritage is turning into a more open and participatory process (Ciolfi 2012). Ciolfi introduces the notion of "heritage sites" to analyse the role of museal institutions in creating and communicating heritage, these are seen as "complex ecologies surrounding the preservation, creation and sharing of heritage" (Ciolfi 2012, p. 69), their mission is "to offer information and knowledge to the visitors" (Ciolfi 2012, p. 71). In order to accomplish their mission, heritage sites

rely on the different competences represented by internal staff and external stakeholders, from management and communication (consultants, designers etc.) to preservation (curators, archivists, guides and/or educators), and other stakeholders that can contribute to the creation of new exhibitions. According to Ciolfi, interaction design is playing a key role in supporting this shift, introducing elements of appropriation and participation in curatorial practice. Appropriation[7] is defined by Ciolfi as "the emergent pattern of use of a system in the hands of the user, rather than its prescribed use" (Ciolfi 2012, p. 70). The second principle is participation, derived from the tradition of participatory design, which advocates for "inclusive processes of design addressing end-users, designers, and other stakeholders" (Ciolfi 2012, p. 70). Building on this understanding of interaction design, Ciolfi argues that through the adoption of an inclusive perspective interaction designers could facilitate the sharing of "social traces", which are defined as new understandings and interpretations of heritage that derive from "people's practices, values and understandings" (Ciolfi 2012, p. 73). Social traces are often invisible, as they are not represented in the same way as heritage is displayed and communicated through artefacts. The social process and interactive outcomes of interaction design could contribute to communicate social traces among different stakeholders and visitors through perceptible representations, enriching a site and expressing the social nature of heritage (Ciolfi 2012). Four case studies are discussed in the article as concrete examples of Ciolfi's scenario; one of these cases is the RFID based exhibition at the Hunt Museum in Limerick, which is already discussed in this chapter (Liam and Bannon 2005). The second case is represented by the *Shannon Portal's Image Wall* for the Shannon International Airport, an interactive wall displaying images of different locations from Ireland, chosen by both practitioners and visitors. The system displays the last 60 images, so that the displayed images change over time. The third case is *The Recipe Station* at the Milk Market in Limerick, which enables the visitors to contribute to a modular recipe book introducing written notes. The last case is *Reminisce*, a mobile application aimed at facilitating tours at the Bunratty Folk Park, an open-air display with reconstructions of old buildings, landscapes, and artefacts. The visitors could also use the application to record their impressions of the display for other visitors to enjoy. In discussing these cases, Ciolfi emphasises how these works contributed to visualising social traces, creating conditions for collaboration across competences inside the museum, but also among visitors and museum practitioners. According to Ciolfi, the involvement of different practitioners has created new roles and understanding of heritage. For instance, the involvement of educators during testing at the Hunt Museum and at Bunratty Folk Park has been fundamental in bringing the exhibition to life, engaging in social interaction with the visitors, even though they are not generally involved in curatorial practice (Ciolfi 2012). At the same time the visitors could provide their personal input in different ways: through selection of images at the Shannon Airport, vocal recordings at the Hunt Museums and Bunratty Folk Park, and written notes at The Milk Market. The temporal aspect was seen as crucial in these exhibits, as from a synchronic perspective the visitors could provide their contribution during their visit interacting with the exhibit, and from a diachronic perspective the visitors could provide feedback through social media after their visit. The use of social media proposed by Ciolfi resembles the scenario proposed by the Parallel Exhibits discussed by Lischke et al. (2014) in the previous sub-section (2.2.1). I find this study meaningful in many ways with respect to my own thesis, first of all Ciolfi acknowledges the on-going shift in the role of museums, looking specifically into the emergence of a participatory curatorial practice. Moreover, similarly to my study, Ciolfi proposes an inclusive perspective to bridge among the different competences involved in the design of digital exhibit and in facilitating the sharing of social traces. In my opinion this particular point leads to methodological questions about which individuals should be involved (visitors, practitioners and stakeholders) and how. This in turn has implications for

[7] A similar term is used in Rogoff (1995) to define one of the three planes of sociocultural activities: participatory appropriation, see chapter 3, section 3.1.

criteria, in order to evaluate how well an exhibit is meeting users' needs. In this sense I see the work of Ciolfi as preparing the ground for the formulation of my inclusive framework, with respect to supporting specific practices and all the individuals involved in this practice.

A similar perspective can be found in McCaw et al. (2014), which discusses a student project conducted in New Zealand, for the promotion of the Olveston residence, which belonged to a prominent family of the town of Dunedin. The studies started with an investigation of the residence and of the learning practices offered to visitors. In this regard it was found that the guided tours provided by Olveston appealed a narrow target group composed of tourists, mainly older women, arriving on a cruise ship. Moreover, the tours lasted for about 60 minutes with "no photography or tour deviation permitted" (McCaw et al. 2014, p. 20). Based on these premises, the students aimed at providing the visitors with alternative ways to engage with the story of the residence, developing different concepts. In the end the concept named *Hunt Toy* was selected, as it was more sustainable from a financial perspective. The Hunt Toy is a mobile application targeted at children, enabling them to find ten toys that were lost in the garden since 1907. The children can find the toys interpreting visual clues positioned on a map. A tracking marker is placed in the location, physically mounted on a peg and the mobile device can allow the children to identify the toys as animated 3D models (McCaw et al. 2014). The design of the toys was inspired by the authentic toys, which are displayed in the house, and by other toys from other historical periods. As the students attempted to turn their concepts into finished products they started facing the challenge of finding sponsors. Therefore, the students decided to rely upon free software development kits and the resources available from their school. In this respect the students realised that the financial challenge is "a challenge for museum professional as well as educators" and that they "need to reconsider each other as financial partners with shared educational values, and able to work together beyond traditional expectations" (McCaw et al. 2014, p. 26). This study is interesting as through a students' project practical matters such as the need of financial support emerged as critical factors affecting the design of digital exhibit, interestingly the use of open source software was found as a suitable solution to reduce the development expenses. This study opens up towards the inclusion of practical matters in the design process, which go beyond the simple involvement of visitors but require the perspective of practitioners, such as curators and educators, whose work is also affected by financial challenges.

These studies, in particular Ciolfi (2012), represent an interesting development in methodological interaction design studies. First of all Ciolfi's aim is close to the aim of this thesis, as she proposes an inclusive perspective with respect to the different professional roles and competences surrounding heritage sites and museums. Moreover, she strives to achieve this perspective through projects involving representatives of the different roles and competences surrounding heritage sites, as discussed also in Hosker et al. (2014) in the sub-section 2.1.1, at the same time creating conditions for visitors' participation in situ and through social media. This study is also implicitly bridging micro and macro level discourses, as through in situ participation the proposed technologies are affecting the social interaction and learning, taking place inside the specific heritage sites. At the same time interdisciplinary collaborations and social media are contributing to the macro level discourse of the on-going shift. McCaw et al. (2014) provide interesting additions, in relation to the limitations that they identify in guided tour practice and on the financial challenge that designers and museum practitioners have to face. I interpret the studies of Ciolfi (2012) and McCaw et al. (2014), together with Roberts (2015), Mason (2015) and Hosker et al. (2014) as opening up towards the need for an interdisciplinary grounding for the design of digital exhibits, through the involvement of representatives of the different disciplines in museum learning practice. Similarly I propose in my thesis that the designer addressing museum learning practice should adopt an interdisciplinary, inclusive framework, to take into account different needs, practices and theoretical inputs that arise from the richness of the

museum context. Moreover, combining the insights gained from the studies mentioned above with those gained from studies such as: Liam and Bannon (2005), Dindler and Iversen (2009), Iversen and Smith (2012), the present thesis aims at exploring further how visitors as well as museum practitioners could be actively involved in the design process, addressing specific museum learning practices offered to the visitors, such as guided tours.

2.3 The practice of guided tours

According to the interviews conducted during the field study, guided tours are highly recommended for children visiting museums, as children might have issues in understanding the actual meaning embodied by the exhibition without guidance. Through a guided tour, children are also enabled to learn notions that could be useful in their future studies. During guided tours, children interact with guides or educators who speak on the behalf of other museum practitioners like curators, historians, and archaeologists, disclosing to the visitors the knowledge embodied in the museum exhibition.

Despite the diffusion of museum guided tours, their nature is far from being understood in depth, since little research has been devoted to this practice, as argued by Best (2012). Several studies, however, discuss the meaningful contribution provided by museum educators to society as a whole in fostering active citizenship and a culture of thinking in young people. Ritchhart (2007) for instance emphasises the role of curators and educators in cultivating "a disposition to think and develop thinking patterns" (Ritchhart 2007, p. 3). Based on observations conducted in several museums of school-group tours with different grades, Ritchhart identifies eight forces in the way educators shape social interaction with visitors inside the museum. Such forces are: expectations, opportunities, allocation of time, modelling of leadership, routines and structures, use of language, set-up of the environment, unfolding of interactions, and relationships (Ritchhart 2007, p. 4). The role of educators depicted by Ritchhart has clear correspondences with the role of adults in apprenticeship (Rogoff 1990), where adults segment sociocultural activity for children, to facilitate them in gaining practical skills and cognitive understanding. However, Ritchhart (2007) does not discuss in-depth the role of visitors as participants in learning activities, so that in the end, it is unclear how the educators' efforts are received and affect the visitors.

More insights about visitors' responses to guided tours can be found in the studies conducted by Best (2012), Pierroux (2010), and Dysthe et al. (2012). I take these three studies as a main reference and model for my own study. As mentioned, Best (2012) points out that a comprehensive understanding of guided tours has not been achieved yet, because of lack of in-depth studies. She also claims that guided tours have been misunderstood, because they are perceived as a static pre-established practice. Instead, she views guided tours as an interactive and situated practice, in which guides and visitors communicate with each other. Best's study is based on the workplace study approach, which builds on conversation analysis and focuses on institutional actions and interactions oriented to routines (Best 2012). Hence, Best has analysed in depth recordings of talk and actions of guides and visitors, trying to define guided tour practice within the institutional framework of museums. The social interaction that takes place during guided tours is affected by the ability of the guides to be receptive to the need of a particular group of visitors. However, she argues that in relation to the existing practice, guided tours need to be enriched, in order to satisfy the needs of a young audience, who has been exposed to digital media in their free time and "an education system that is more interactive and less didactic than the typical guided tour" (Best 2012, p. 15). For this reason, Best concludes that more studies are needed to investigate further and improve the quality of guided tour practice. I see Best's study as

valuable for the study of guided tours and museum learning practice in general and as a good point of departure for this thesis.

Pierroux (2010) has investigated guided tours as semiotic resources of meaning making, within the context of art museums. Pierroux found that the practice of guided tour is affected by two main narratives: the formalist and the contextualist. The formalist narrative, represented by the Museum of Modern Art (MoMA) in New York, and the contextualist narrative represented instead by the Philadelphia Museum of Art. These two narratives promote different approaches to learning. For instance, the formalist narrative encourages inexperienced visitors to approach new works of art emphasising intuitive thinking instead of institutional knowledge. Pierroux names this narrative formalist as it considers "form inseparable from content because it is grounded in the social and cultural conditions of a specific time by means of the creative act" (Pierroux 2010, p. 422). As a result, the formalist narrative admits as legitimate the emergence of individual and differentiated learning outcomes based on how the visitors relate to the form of specific works of art. On the other hand, the contextualist narrative "prioritises assessment and disciplinary content" in museum learning practice (Pierroux 2010, p. 7), in order to secure that visitors are able to gain the officially accredited knowledge and avoid misunderstandings. Pierroux names this narrative contextualist as it is centred on the principle that in order to enable visitors to grasp the meaning embodied in a work of art, it is necessary to provide "contextual information" defining the circumstances in which the work of art was created (Pierroux 2010, p. 423-424). The two approaches were compared by Pierroux through ethnographic observations of a guided tour in each of the museums. The goal of the study was to find out how the two narratives are embedded in art education and how they affect learning and social interaction. Similarly to Best (2012), Pierroux emphasises the situated character of guided tours; therefore, she based her study on discourse analysis of video recordings taken on site. Results suggest that although applying opposite methods, the educators from the two museums adopted similar strategies regarding facilitation. They requested explanations about the displayed artefacts, reformulated students' responses, and connected previous utterances together. Expressions of "ownership or appropriation" in the forms of multiple interpretations emerged in both tours through negotiations, agreements, and disagreements (Pierroux 2010, p. 445). However, the formalist narrative appears more suitable for supporting individual analysis of art works, as the educators did not focus their talk exclusively on the displayed art and students were invited to participate in an active way to the interpretive discourse. Pierroux concludes that the formalist approach better supports the creation of meaning by the young visitors, empowering them to form identities as meaning makers inside the museum. This study provides an interesting contribution to the understanding of guided tours, in which the displayed artefacts and the visitors' interpretations of the same artefacts can both act as boundary objects between visitors and guides, in the terms of Star and Griesemer (1989). In fact, it emerges from Pierroux's analysis that similarly to the displayed art works, visitors' interpretation of these works can also be discussed and negotiated, contributing to the emergence of a mutual understanding between visitors and educators.

The need to support personal interpretations is acknowledged also by the study conducted by Dysthe et al. (2012), which specifically addresses the Danish context. This study is based on detailed observations of workshops involving guides and groups of school pupils, reflecting upon museum learning practice implicitly linking the micro level (dealing with what happens inside a specific museum) and macro level (dealing with museums, their organisational identity and their role within society) discourses. The authors argue that museum workshops have shifted from traditional teaching towards forms of dialogue-based teaching, in which guides do not aim at passing the official knowledge about art, but rather at engaging in a dialogue with the visitors about how art works can be interpreted. This shift in museum learning practice is considered critical in redefining the role of museums within society. Similarly to Hooper-Greenhill et al.

(2004; 2000), Dysthe et al. point out that by fostering a dialogue with visitors, museums play a central role in cultivating active citizenship and social inclusion in young people. This aspect is especially important in supporting the integration of immigrants in contemporary multi-ethnic societies, which include individuals coming from different cultures (Dysthe et al. 2012). Moreover, the authors interpret the process of the shift in the role of museums as a change from the modernist paradigm of museum learning practice towards the post-modern one, in connection to broader sociocultural changes; this same perspective is supported by Lang et al. (2006). The modernist paradigm is defined by the authors as a totalitarian understanding of museum learning practice, where one single official truth is accepted and has to be passed to the visitors. On the other hand, the post-modern paradigm of museum learning practice values dialogue and the exchange of various understandings on the exhibition.

Combining the perspectives discussed by Pierroux (2010) and Dysthe et al. (2012), I find that the contextualist narrative described by Pierroux converges towards Dysthe's modernist paradigm. On the contrary, the formalist narrative converges with the post-modern museum, as they both acknowledge that more versions of the truth exist and that individual visitors can gain personal knowledge from their visit depending on their previous experiences and cultural background.

The studies covered in this section represent a step forward towards the emergence of an inclusive perspective on museum learning practice, as they analyse museum practice combining insights related to the individual participants, their sociocultural context, and the role of museums within society. However, these studies are not concerned with design or with the digitisation of museum learning practice. In this respect the studies conducted by Ciolfi (2012), McCaw et al. (2014), and Apostolellis and Bowman (2015), represent a step forward towards the inclusive framework I formulate in this thesis. Even though these studies do not explicitly deal with the fragmentation between macro and micro level discourses, they are implicitly contributing to bridge the two discourses, including insights about the professional competences and roles of guides within museum learning practice in interaction design studies. More specifically Ciolfi (2012) acknowledges the relevance of educators and guides in creating engagement for the visitors, hence she argues in favour of including those professionals in the design process. McCaw et al. (2014) briefly discuss the limitations of the guided tours offered at the Olveston historical residence. More specifically McCaw et al. find that guided tours at Olveston are: "spoken, and connect stories of the family, the rooms and the collections of objects in the rooms", moreover these tours "appeal most to older women, exposing a lack of activities or areas of engagement for mixed groups including youth and children" (McCaw et al. 2014, p. 20). Finally Apostolellis and Bowman (2015) argue that even though their study does not take into account the richness of museum learning practice, the facilitation provided by expert guides fostered "greater learning gains" than when the same exhibit was tested without the guides' facilitation (Apostolellis and Bowman 2015, p. 160). In conclusion these interaction design studies provide meaningful insights in relation to how visitors might be affected by guided tours (McCaw et al. 2014; Ciolfi 2012) and present also evidence pointing at the fact that guides can play an important role for learning and engagement also when visitors are facilitated by digital exhibits (Apostolellis and Bowman 2015; Ciolfi 2012). However, the mentioned studies do not take into account the possibility to design for the guided tour and do not investigate how a digital exhibit could enrich the guided tour for both guides and young visitors. It is, therefore, my intention to combine the insights provided by these studies with a research-oriented design intervention, in order to bridge micro and macro level discourses and investigate the role of digital technologies within museum learning practice, taking the guided tour as a specific case. In order to do so, the next chapter will outline the theoretical foundations of the thesis.

3. Theoretical foundations

This chapter is structured into four different sections, discussing how the theoretical framework chosen for this study can enable me to address the research questions. Hence section 3.1 discusses how the selected theories can support me in investigating the main research question, which deals with how to contribute to the shift in the role of museums. Section 3.2 discusses how these theories can enable me to investigate what are the sociocultural factors involved in museum learning practice, which is the focus of the first sub-question. Finally section 3.3 and 3.4 reflect respectively on the second and third sub-question, where 3.3 focuses on how the chosen theories can contribute to the investigation of the role of digital technologies within the practice of guided tours and 3.4 discusses the theories I refer to in order to investigate how digital technologies could contribute to learning of history inside the museum.

The theoretical framework of this thesis builds on sociocultural studies, specifically on three main concepts: the first is the notion of *apprenticeship in thinking*, which is introduced by Rogoff (1990) to discuss how children engage in learning together with adults in informal learning contexts. The second is the notion of *play* as a resource for the emergence of *conceptual thinking* in children, which was introduced by Vygotsky (1978). The third concept is the one of *mediated action*, which was introduced by Wertsch (1991) and grounded on Vygotsky's studies, to analyse how people engage in social interaction and learning through their physical objects and environment.

Rogoff's (1990) notion of "apprenticeship in thinking" provides rich insights and methodological guidelines to investigate how learning takes place when adults and children interact in informal contexts (this is further discussed in section 3.2). Moreover, Rogoff uses this notion to analyse learning practice from the perspective of the individuals involved and the values of their sociocultural context. In this sense, Rogoff proposes an inclusive perspective of learning, in which learning practice is investigated also in relation to the different levels of the individuals involved, the institution and the society in which the learning practice takes place. Therefore, I find that the notion of apprenticeship in thinking can support me in investigating my main research question, which deals with how I can conduct a design investigation that can contribute to the shift in the role of museums. At the same time I find that this notion provides already a meaningful grounding for the formulation of an inclusive framework, which integrates micro and macro level discourses in my study. In this respect Rogoff analyses learning from the perspective of three different planes of analysis: the personal, interpersonal and community/institutional (Rogoff 1995) (section 3.1). In this way Rogoff is able to explain how learning practice is affected by the values expressed by the surrounding community (which correspond to the macro level in my thesis), and not only by what occurs among the individual participants (which corresponds to the micro level in my thesis). I find that applying these three planes to the case of the digitisation of museum learning practice, it should become clearer how museum learning practice and the on-going shift are affected by sociocultural factors related to the institutional and societal level of museum practice. Therefore, I argue that Rogoff's studies can provide a meaningful contribution to the investigation of the first sub-question, which deals with the sociocultural factors involved in museum learning practice.

In my thesis I refer to the work of Vygotsky and Wertsch as foundations to Rogoff's own research, in particular in relation to the role of mediated play in supporting learning. Rogoff builds on Vygotsky (1978, 1967), in particular regarding his discussion about the role of play in children's development (section 3.3). Vygotsky contributed to laying the foundation of the notion of playful learning, intended as an integration of play and learning (Resnick 2004). Moreover, according to DeVane and Squire (2012) researchers dealing with learning technologies refer to Vygotsky, as his work enables them to analyse and discuss how learning takes place in the real world. At the same time Price et al. (2003) refer to Rogoff (1990) to discuss how children's

learning benefits from social interaction and collaboration with peers and adults. However, none of these authors uses the term "playful learning" in the publications I refer to in my thesis. Interestingly Vygotsky, Wertsch and Rogoff do not explicitly talk about playful learning, nevertheless I find that they provide meaningful analytical tools to study how playful learning could be supported; this matter will be discussed more in depth in section 3.3. Hence starting from Vygotsky (1978), who argues that play mediated by physical objects elicits in children forms of conceptual thinking, play and learning are seen in this thesis as strictly interconnected. Play triggers curiosity and formulation of questions, which in turn may lead towards communication among learners and facilitators. Through questions, learners seek notions that are interesting for them through the help of their facilitators, becoming active participants in their learning process (this is further discussed in section 3.3 and Paper 4). In the case of museums, forms of playful learning could emerge in situations in which young visitors engage in play with each other and with museum educators while looking at the exhibition. The work of Rogoff is also inspired by Wertsch, who similarly to Vygotsky, analyses the role of physical objects in social interaction and how interaction and responsibility transfer between children and adults takes place in situations of learning (Wertsch 1991). Therefore, I see the theories of Vygotsky and Wertsch on play and learning, as meaningful perspectives to investigate the second sub-question, dealing with how a playful digital installation could enrich the practice of guided tours. Wertsch on the other hand refers to Vygotsky as he focuses on "mediated action" or "mediation" (Wertsch 1991, p. 19), which he defines as human action taking place through physical objects or "meditational means" (Wertsch 1991, p. 12). Wertsch's notion of mediated action builds on the work of Vygotsky among other Soviet scholars, according to whom physical objects and the environment play a fundamental role in the way humans interact with each other (Wertsch 1991, p. 8). I interpret Vygotsky's notion of play as a special instance of Wertsch's mediated action, in which players interact with each other through their toys and their environment. Taking these insights into account, in this thesis I use the term playful learning to indicate a scenario in which learning is supported by play mediated by physical objects, which I call in short mediated play. My study builds on these three authors to investigate the possibility of turning guided tours into a *playful apprenticeship*, in which through mediated play, guides and children can equally contribute to the on-going learning process from their individual perspective.

Moreover, since the goal of guided tours conducted in historical museums is to facilitate the visitors in learning about history (section 3.4), this thesis also investigates how digital technologies could contribute to communicate historical knowledge. For this purpose this thesis builds on the work of Carr (2001), to gain an understanding of what history is and how it could be represented in a digital exhibit. Carr sees history as the result of social processes, in two ways: first as a process in which humans are involved as social beings participating more or less willingly to the emergence of what we call historical facts; second history is the result of an analysis conducted by historians at a later time from when those social facts happened. The studies of prominent historians like Huizinga (1937), Bloch (1990), and Le Goff (1990) are discussed in this thesis as they provide examples of the application of Carr's theory to the understanding of history, I see their perspective as contributing to the formulation of design requirements, in relation to how historical facts could be represented in a digital exhibit.

3.1 Rogoff's analytical planes: a framework to design for the shift of museum learning practice

The framework formulated by Rogoff for the study of sociocultural activity provides a tool to address the main research question and analyse how the design of learning technologies can

contribute to the on-going shift in the role of museums, hence bridging micro and macro level discourses.

This thesis builds on the notion that introduction of new learning technologies in a mediated practice is never neutral; on the contrary, it affects the practice in its integrity. It creates new expectations for teachers and learners in relation to social interaction with partners, their available materials, and their attitude during learning practice (Säljö 2010). The introduction of new technologies affects practice also at its institutional macro level perspective, dealing for instance with traditions, norms and regulations, and financial issues (de Freitas and Oliver 2005). The work of Rogoff on learning and sociocultural activity supported me to better understand how new technologies, intended as new learning tools, can affect learning practice in relation to the interconnection between the individuals involved and their community.

One of the main inspirations to Rogoff's work is provided by Dewey's studies on learning, and Rogoff specifically refers to him in her study about apprenticeship in thinking (Rogoff 1990, p. 28). Two dominant themes discussed by Dewey have provided foundation for Rogoff's theories, such as: the role of adults and of personal experience in children's learning. Dewey emphasises how teachers can facilitate learning by arranging activities for children as well as being open to children's needs by including spaces for free play (Dewey 1938). At the same time, Dewey (1916) argues that learning takes place through personal experience within the broad sphere of school, family life, and social relations in general. Similarly to Rogoff (1995, 1990), Dewey (1916) discusses how joining adults' activities constitutes for children an opportunity for learning and play. In this respect, Rogoff discusses the value of experience in learning through the lens of participation in sociocultural activities and guidance. Through her metaphor of apprenticeship, Rogoff refers to a specific experience in which novices learn from more expert peers, so that she restricts her focus to how learning takes place through modalities of interaction and guidance. In this sense, I find that Rogoff provides a specific framework that can support an in-depth analysis of guided tours, as aimed in this thesis.

Rogoff's approach focuses on how children acquire knowledge and skills by participating in socioculturally organised activities together with other children and adults, who function as facilitators (Rogoff 1995, 1990, 2015). Starting from learning, she opens up towards including micro and macro level perspectives of socioculturally organised activities, which are deeply interconnected. Rogoff argues that in general research on learning has focused on the individual or the environment, considered as separated entities (Rogoff 2015). She also argues that some researchers are overlooking at "the depth of research conducted in the field of learning that focuses on the participation and mutual contribution of learners and their teachers" Rogoff (2015, p. 42). She also states that an issue in this discussion is that teaching is still identified with "schoolish instruction" (Rogoff 2015, p. 42), while teaching activities in non-formal contexts are not given enough consideration. I argue that a similar tendency in separating the individual and the environment can be found in the fragmentation between micro and macro level discourses in the study of museum learning practice. Museum studies tend to focus on the environment of museums, discussing for instance the shift (Janes 2009; Reeve and Woollard 2006) or the role of museum educators in museum learning practices (Ritchhart 2007), but without taking into account the visitors as individuals who approach the museums. On the other hand, interaction design studies tend to view visitors as individuals who approach the museums on their own, as argued by Hornecker and Stifter (2006), but without taking into account what the museum environment offers to them. Rogoff claims instead that the individual and the environment are mutually interconnected and builds on Vygotsky because he was "interested in the mutuality of the individual and the environment" and he concretised his interest by choosing a unit of analysis that "preserves the essence of the events of interest rather than separating an event into elements that no longer function as does the whole" (Rogoff 1995, p. 139). This is the sociocultural perspective adopted in this thesis, in which guided tours function as a unit of analysis preserving

the essence of the central events and of the levels involved. In this respect, Rogoff points out that the separation between the individual and the environment does not support a proper understanding of sociocultural activity and of learning processes, as they lose their meaning when isolated.

Therefore, Rogoff proposes to study children's learning through three main planes of analysis: community/institutional, interpersonal, and personal (Rogoff 1995). I see these three planes as corresponding to micro and macro level discourses in the study of museum learning practice and as inspiration for the inclusive perspective formulated in this thesis. The macro level discourse corresponds to the community/institutional plane, as the macro level deals with the perspective of the local society surrounding museum learning practice, including for instance local schools, municipalities and ministries of education. The micro level discourse deals instead with the interaction taking place among the individuals inside the museums, hence the micro level corresponds to both personal and interpersonal planes.

Furthermore, Rogoff (1995) argues that these three different planes of focus correspond to three main developmental processes called: apprenticeship, guided participation, and participatory appropriation.

Apprenticeship corresponds to the community plane as it involves a group of active individuals participating in "culturally organized activities," whose goal is "to prepare less experienced individuals into mature participation" (Rogoff 1995, p. 141). The process of apprenticeship extends the idea of craft apprenticeship to any other sociocultural activity, such as: schooling, work or family relations, focusing on the nature of the activity as well as on "its relation to practices and institutions of the community in which it occurs" (Rogoff 1995, p. 141). In this respect, whatever activity is selected as unit of analysis, it can be understood in relation to its community. Guided tours for instance can be analysed as a sociocultural activity that takes place in museums and is affected on the community plane by the relations between museums and other institutions and between museums and citizens.

The process of guided participation corresponds to the interpersonal plane and deals with the "processes and systems of involvement between people" in the joint effort of participating in culturally organised activities (Rogoff 1995, p. 141). These processes and systems involve different forms of communication and interaction among the participants, such as face-to-face interaction and also remote, distal arrangements that do not require physical presence, depending on how the individuals are involved in a specific activity and community (Rogoff 1995). Rogoff also points out that the term "guided" refers more specifically to the direction offered by cultural and social values, in relation to how guidance is provided during the activity. For instance, guided participation could be performed through frontal teaching, but in recent time, distant learning involving tutoring and online resources has become common practice. When applied to museum learning practice, the interpersonal plane of analysis enabled me to reflect more specifically at the connection between guided tours and museum learning practice in general, and how institutional concerns and traditions might affect how guided participation is provided during guided tours.

Finally, the process of participatory appropriation corresponds to the individual plane and refers to how "individuals change through their involvement" in a specific activity (Rogoff 1995, p. 141). The process of participatory appropriation is explained by Rogoff as the process through which an individual becomes more prepared to attend future related activities. I see the personal plane of analysis as having methodological implications, it enabled me to see that it was important to analyse how different individuals participate in museum learning practice, and in the guided tours in particular, in order to gain new knowledge on such practices. Studies like Ritchhart (2007) analyse the role of the guides or educators in facilitating the visitors, while Falk (2012) focuses on the visitors' different motivations to go to the museum. I find that both studies provide interesting insights about museum learning practice, however, I see their discussions as

providing a fragmented picture of museum learning practice. For instance, from Ritchhart's study I could gain an understanding of guides' practice and inspirations to explore how to support the guides, but as Ritchhart is not taking into account how the visitors are affected by the guides' facilitation, it makes it hard for me to understand if the guides' effort has given any benefits to the visitors and where there could be opportunities for improvement in relation to how the guides wish to affect the visitors. Similarly, since Falk is analysing visitors' motivation to come to the museum but not how they engage in museum learning practices, Falk's study enables me to gain an understanding and eventually design requirements in relation to how differently visitors might approach the museum. However, Falk can provide limited support when trying to understand how these same visitors approach the learning practices offered by museums. In this sense the mentioned studies can provide a fragmented understanding of museum learning practice, while I find that in order to study the role of digital technologies within museum learning practice a richer reconstruction on the practice is needed, representing the perspectives of all the participants. Through the perspective of the process of appropriation I could see that in order to understand the nature of museum learning practice, I had to investigate how each of the individuals involved perceive such practice in relation to his or her expectations. This in turn implies from a more concrete perspective that the design of new exhibits could play a fundamental role in creating conditions to meet the needs of the different participants and to elicit a dialogue among them. The studies of Best (2012), Ciolfi (2012) and of Roberts (2014) provide in this respect richer insights, moving towards the acknowledgement of the different perspectives represented by the visitors, the guides and also the other practitioners who participate in guided tours (Best 2012) but also in creating exhibits and other activities (Roberts 2014; Ciolfi 2012).

Summing up, applying these three planes of analysis to guided tours, it results that guided tours are a sociocultural activity. From the perspective of the community/apprenticeship plane, guided tours can be compared to schooling activities, in which children and adults participate, in order to prepare the children to contribute to their society. From the perspective of guided participation, guided tours involve face-to-face interaction, in which adults (guides or teachers) act as facilitators. Finally, from the perspective of participatory appropriation, individuals participating in guided tours are expected to become more knowledgeable about the content of museums' exhibitions and to participate in future museum arrangements. From a broader perspective, children attending guided tours are expected to become active, educated citizens participating in the life of their community (Dysthe et al. 2012). In my thesis, I interpret each of these three planes as corresponding mainly to their respective processes. However, each of the processes can be analysed and understood also from the perspective of the other planes.

I consider the adoption of the three planes of analysis discussed by Rogoff as a useful perspective to investigate my main research question, as these can enable me to analyse the different levels of museum learning practice in view of formulating an inclusive framework, but also as constituting museum learning practice as a whole, bridging micro and macro level discourses. In this way I see Rogoff's planes as clarifying why an inclusive perspective is needed and what are the aspects that should be taken into account in its formulation.

Moreover, through the adoption of Rogoff's sociocultural approach, it follows that as a new digital technology is introduced to enrich the guided tours, this same technology will affect museum learning practice from each of the three planes with consequences on how the museum is perceived by its community (citizens and external institutions), hence affecting also the shift in the role of museums. The introduction of digital technologies in museums is said in interaction design studies to affect how individual visitors access knowledge, for instance by Hornecker and Stifter (2006), from the perspective of the individual plane. This in turn affects how visitors interact with each other on an interpersonal plane, for instance how children and parents interact with each other when playing inside the museum in Muise and Wakkary (2010). In the context of

this thesis, the introduction of digital technologies is expected to affect how guides and children interact with each other during guided tours. Moreover, the introduction of digital technologies is seen in interaction design studies as enriching young visitors' experience, for instance bridging young visitors' everyday life and museum experience, as explained for instance in Dindler and Iversen (2009). In this way, Dindler and Iversen are expanding the claim of Hornecker and Stifter, as they are moving out of the museum and from the interpersonal plane towards the community plane, in order to link the visitors' personal life and interests to their museum experience. If technologies can actually bridge the visitors' life and the museum, then new expectations in the visitors are supposed to emerge in relation to how far is the museum experience from their interests. This in turn could be a valuable strategy to improve the effectiveness of museums in engaging with a broader group of visitors, as discussed by Fleming (2005) and Reeve and Woollard (2006) from a macro level-organisational perspective. It is in this respect that I see Rogoff's theory of apprenticeship and her three planes of analysis as supporting a richer understanding of museum learning practice, representing the different perspectives of the individuals involved.

These same insights can be taken as point of departure to support a preliminary formulation of design requirements for the design of MicroCulture, with the aim of contributing to museum learning practice in relation to the on-going shift. For instance the adoption of the three planes of analysis suggested that from the perspective of the community/institutional-apprenticeship plane, the design of MicroCulture should take into account the traditions and needs of museums as institutions. In turn the institutional needs expressed by the museums are to be seen as an expression of the values of the community these participate in, which might include relations to public schools or constraints in exhibition planning. At the same time, from the perspective of the community-apprenticeship plane MicroCulture should be designed to contribute to the formation of new citizens, who are aware of their cultural heritage and are able to contribute to their community. These aspects are also discussed by Dysthe et al. (2012) as central aspects of the shift of museums from the modernist to the post-modern paradigm. Taking into account the interpersonal-guided participation plane, the design of MicroCulture should aim at supporting the specific modalities of facilitation adopted by the specific museal institutions involved in my study. Being guided tours the main focus, I should explore how MicroCulture could enrich the face-to-face interaction in which guides and children are supposed to engage. Finally from the perspective of the personal-participatory appropriation plane, the design of MicroCulture should aim at supporting the needs of the individuals participating in museum learning practice and guided tours. Individual practitioners should, therefore, be supported according to how they personally are comfortable in interacting with visitors and in using technologies. On the other hand, children should be enabled to choose to a certain extent their path of actions and to decide how to play. In this respect, MicroCulture could be an open-ended exhibit that do not impose specific rules of play, as discussed in Paper 3 and chapter 6.

3.2 Studying the sociocultural factors in museum learning practice

This section proposes a discussion about how the metaphor of apprenticeship in thinking discussed by Rogoff (1990) can support my analysis of the sociocultural factors involved in museum learning practice and in the guided tours and then to investigate my first sub-question. From a more practical perspective it follows that the perspective of apprenticeship can support designers in identifying the key sociocultural factors influencing museum learning practice and its digitisation, enabling them to meet the needs of practitioners and visitors in their design

interventions. Thereby, museum learning practice is contextualised within a broader societal perspective.

I have used the metaphor of apprenticeship in thinking to investigate my first sub-question because it enables me to look at museum learning practice as a complex sociocultural activity, characterised by different sociocultural factors. Similarly to Rogoff's definition of sociocultural activity, museum learning practice includes various forms of guided participation, among which are free and guided tours, exhibition planning, and indirect practices like web pages and publications (Lang et al. 2006). Each of these practices is in turn mediated and affected by traditions, norms, expectations, physical environment and artefacts, as well as administrative rules and issues pertaining museum learning practice in general; I see all of these as sociocultural factors that are involved in museum learning practice, because these can affect and contribute to the way museum learning practice and the acquisition of new artefacts take place. Some of these factors are identified and discussed in the museum literature discussed in chapter 2 of this thesis. For instance when discussing the influence of external institutions on the autonomy of museums in deciding upon their practice (Reeve and Woollard 2006; Hooper-Greenhill et al. 2004), or the professional expertise of museum practitioners (Woollard 2006), and also the goals, cultural values, and traditions of museum learning practice (Dysthe et al. 2012; Best 2012; Pierroux 2010).

The adoption of the sociocultural approach defined in Rogoff (1995) enables me to uncover these factors in the specific context of the museums that participated in this study. As already mention in 3.1, Rogoff proposes an approach to learning that builds on Vygotsky to interconnect the environment and the individual, selecting a particular activity as unit of analysis (Rogoff 1995). This selected activity is studied in relation to "active and dynamic participation from individuals, their social partners, and historical traditions and materials and their transformations" (Rogoff 1995, p. 150). All these aspects are seen by Rogoff as fundamental to children's learning and enable Rogoff to gain in her studies, the inclusive perspective about the individual and the environment that is desired for the study of museum learning practice in this thesis.

Vygotsky (1978) argues that children learn while interacting with their social environment, which includes the facilitation provided by other children or by adults. Building on Vygotsky's views on learning, Rogoff uses apprenticeship in thinking as a metaphor to study how children learn. She argues that similarly to apprentices of a craft, children act as "apprentices in thinking" (Rogoff 1990, p. 7), who are active in learning how to solve problems that are culturally defined with available tools and attempt to construct new solutions (Rogoff 1990). In this respect, Rogoff, together with Vygotsky (1978) and Wertsch (1991), argues that learning is embedded in the social relationship and the tools available within the sociocultural activity children participate in. The framework provided by Rogoff emphasises the need for three main conditions in fostering children's learning (Rogoff 1990, p. 8), which are mentioned below:

1. Children's active role in learning and in making use of social guidance;
2. The importance of tacit and routine arrangements within children's activities that are not intended to be instructional;
3. Cultural variation in the goals of learning and in the means by which children achieve a shared understanding with their facilitators and mates.

Rogoff develops the concept of guided participation to emphasise that "guidance and participation in culturally valued activities are essential to children's apprenticeship in thinking" (Rogoff 1990, p. 8). A central aspect of guided participation is, according to Rogoff, the active participation of children and adults in collaborative activities. Underlying guided participation is

the concept of "intersubjectivity," defined by Rogoff as a "sharing of focus and purpose" between children and adults and also between children and their peers (Rogoff 1990, p. 8). All participants must be reflective on how they can support each other working towards the common goal of fulfilling the goal(s) embedded in the activity. In order to learn, children must use the available social resources for guidance, actively asking for support when needed. At the same time, children's participation in everyday activities, which are not intended to be instructional (such as food preparations, sport or rituals), and their tacit arrangements enable the children in gaining an understanding and skills in managing the needs of their community. Finally, the children are enabled to achieve a deeper understanding on how to contribute to their community, through cultural variation in the goals of the development and the available means, such as "explanation, discussion, expert models, joint participation, active observation, and arrangement in children roles" (Rogoff 1990, p. 8). I interpret in this thesis the notion of cultural variation as a result of intersubjectivity in line with Best (2012), in the sense that by being responsive to each other children and adults continually renegotiate their learning goals and which resources they need to pursue their learning goals.

When analysing museum learning practice through the metaphor of apprenticeship, and more specifically the guided tours, guided participation corresponds to the particular form in which museum practitioners facilitate learning for their visitors, for instance arranging exhibitions, cultural events, or even guided tours. Hence, looking closer at the practice of guided tours, guided participation corresponds to the social interaction occurring between guides and children. The specific way in which guided participation unfolds in contexts of learning is affected by explicit and tacit arrangements, including use of available resources such as: discussion, explanations, reconstructions, artefacts, and explanatory signs. Moreover, in order to learn something from guided tours, children need to make active use of the social guidance provided by the guides and engage in a negotiation of meaning and use of the available resources. Through this negotiation, children and guides can achieve a variation in the goals of learning, so that new learning goals are established for the children and new use of means is decided accordingly.

From a macro level perspective learning goals are emerging in relation to the skills that are valued in each community. Rogoff reports as example the case of middle-class, American society, in which the skills provided by schooling, such as: "formal operational, scientific reasoning, literate communication, mathematical facility" (Rogoff 1990, p. 12) correspond to the skills required for participation in the economic and political aspects of adult life. On the other hand, different learning goals and practices might be found in other communities, where other skills are valued for participation in adult life.

This connection between social values and learning goals is visible also in the context of museums and guided tours, when analysing museum learning practice from Rogoff's perspective, museum learning practice is defined according to the importance given to historical and cultural knowledge by our society, for instance as a mean for social inclusion (Dysthe et al. 2012; Hooper-Greenhill et al. 2004). Moreover, the studies conducted by Best (2012), Pierroux (2010), and Ritchhart (2007)[8] discuss the role of the museum educator in line with Rogoff (1990), as a facilitator who is in charge of segmenting activities for children, defining specific routines and tasks based on the visitors' needs. In this respect, the convergence between schooling practice and the skills valued in Western society has caused a convergence also between museum and school learning practices and the respective role of the teachers. I find that this convergence explains why according to current literature museums are expected to adapt to the demands of the school system (Reeve and Woollard 2006). Interestingly Pierroux (2010) shows how different sociocultural traditions affect guides' actions in relation to children's learning and social

[8] See chapter 2, section 2.3.

interaction. For instance, Pierroux emphasises how at the MOMA museum, which adopts the formalist narrative, guides do not focus their talk only on artefacts but also on allowing visitors to express their own interpretations of the artefacts. On the other hand, when comparing studies on guided tours with sociocultural studies like Rogoff (1990) and Wertsch (1991), I find that the notion of visitors' participation in the guided tours is limited mainly to guides' openness in acknowledging validity to the young visitors' individual interpretations of the exhibition content, as in Pierroux (2010) and not in relation to allowing for free courses of actions. In my analysis this aspect of current practice of guided tours appears in contrast with the learners' active role envisioned by Rogoff (1990) and Vygotsky (1978) according to whom larger degrees of independence have to be granted to learners, and also by interaction design studies (Muise and Wakkary 2010; Iversen and Smith 2012; Apostolellis and Bowman 2015) that promote shared problem-solving activities and playful interactions to foster visitors' engagement.

Building on Rogoff's notion of learning through children's active participation in non-instructional activities, this thesis proposes a twist to the traditional guided tour, reformulating the interaction between the children and the guides introducing the non-instructional skilled activity of playing a digital game, in order to empower the children in exploring their path of actions more freely, making more active use of social guidance, and in expressing their needs to the guides. However, this thesis builds on the assumption that in order to introduce new technologies and interactions that could support children's empowerment, it is necessary to find out about how the museums involved in the study relate to the school system of their sociocultural context and which practices, skills, and norms are reinforced in that context, as discussed in Paper 1. If this is not done, the proposed technologies might be found unusable by museum practitioners. Therefore, I see Rogoff's metaphor of apprenticeship as a theoretical tool enabling me to grasp the nature and factors involved in museum learning practice. From a practice-oriented perspective I see the metaphor of apprenticeship as a tool that can enable me and other designers to contextualise the creation of new digital exhibits.

Taking into account how museum learning practice can be analysed through the metaphor of apprenticeship and which factors appear as central, I was able to identify early in my process a few design requirements for the design of MicroCulture. The first requirement for MicroCulture would be to facilitate the children in making active use of social guidance, so that they could engage in interacting with the guides as active participants. Second the technologies should not disrupt but support tacit routines involved in museum learning practice and of guided tours in particular, in order to meet the expectations of practitioners and visitors on the learning practice at hand. This also means that a new exhibit has to fit within the physical layout of the whole exhibition contributing to its meaning. At the same time offering support to tacit routines will avoid the museum practitioners from unnecessary effort in relating to the new exhibit. MicroCulture should also support forms of cultural variation in the practice, avoiding the imposition of rigid interactions and rules. This in turn implies that MicroCulture should also enable the children to choose free paths of actions in their own play, granted the limits of the museum contexts. From a macro level perspective, the design of MicroCulture should carefully target the learning goals of the museum, seen as an expression of the competences that the community expect from adult citizens.

3.3 Playful learning and mediated play as means to enrich the guided tour

It is proposed in this thesis that digital technologies could contribute to museum learning practice, enriching social interaction during the guided tour through forms of playful learning.

This section introduces the theoretical perspectives of Rogoff, Vygostsky and Wertsch, which are used in this thesis to address the research questions and the design of MicroCulture. I find these perspectives meaningful to address all my research questions and in particular the second sub-question, which deals with how digital technologies could enrich the guided tour, because from a theoretical level they can enable me to analyse the role of exhibits in supporting children's learning and guide's facilitation in the practice of guided tour.

The theories discussed in this chapter relate to the concept of playful learning in different ways. Interestingly none of the three authors (Vygotsky, Rogoff and Wertsch) explicitly uses the term playful learning, nevertheless their theories provide meaningful perspectives to understand how children can learn through play. Vygotsky in particular is seen as having contributed in laying the theoretical foundations of playful learning defined as an integration of play and learning, where exploration and experiments are core parts of children's play experience (Resnick 2004). Moreover, central aspects of playful learning are identified in mediation of physical objects and social interaction (Price et al. 2003), as pointed out by Vygotsky (1978) but also Rogoff (1990) and Wertsch (1991). Combining the perspectives of Vygotsky (1978) who investigated how play mediated by physical objects fosters abstract thinking in children, and Wertsch (1991) who focused on the role of mediated action in learning, I use the term mediated to indicate the particular form of play that is required in playful learning according to existing research (Price et al 2003). And then I use playful learning to indicate the integration between learning and mediated play. In my thesis I see the introduction of mediated play as a resource to turn guided tours into a playful learning practice, in which learning of history is integrated and fostered by forms of mediated play between children and guides.

According to DeVane and Squire (2012) Vygotsky and the school of activity theory, which builds on the studies of Vygosky, is seen as providing "designers, teachers and scholars with a systematic way to understand the real world" and "how learning with technology occurs with activity in the real world" and not in idealised settings (DeVane and Squire 2012, p. 263). The two authors point out that Vygotsky provided a new perspective on learning, where any aspect of children's cultural development "appears first on the social plane and then on the psychological plane" (DeVane and Squire 2012, p. 245). In this way Vygotsky is indicating social interaction between humans as the "location of learning, rather than the lone, isolated individual" (DeVane and Squire 2012, p. 245). So defined Vygotsky's studies can provide researchers with evidence that support the need for playful learning and for the design of technologies supporting social playful experiences. Furthermore DeVane and Squire (2012) argue that researchers dealing with the design of learning technologies have in different ways referred to Vygotskian psychology, either through direct references as I see in Apostolellis and Bowman (2015) or through similar cases as I see in Muise and Wakkary (2010) and Price et al. (2003). The study conducted by Apostolellis and Bowman, which is also discussed in chapter 2, aimed at studying the sociocultural factors that affect the learning experience of young visitors inside the museum. The two authors refer to Vygotsky mainly in relation to the role of the sociocultural context in learning. At the same time Apostolellis and Bowman discuss the role of social mediation in learning, when coordinated action from learners or support from adults is needed to achieve a specific goal. Similarly Muise and Wakkary (2010), also discussed in chapter 2, present their results from testing a newly developed digital technology. These two authors started from the perspective of enabling families to engage in shared problem solving through role play, and argued that their technology was able to elicit "visitors' playful and curious interactions with museum exhibits" (Muise and Wakkary 2010, p. 215). Other researchers like Rogoff (1990) specifically refer to Vygotsky's work to study the role of play and social interaction in learning. Hill (2012) who investigates communities of learning refers to Vygotsky as "the perhaps most well-known theorist influencing social constructivist theory as well as the thinking about learning communities" (Hill 2012, p. 86). At the same time Price et al. (2003) refers to Rogoff's book on

apprenticeships, which I use in my thesis (Rogoff 1990), to discuss the social aspect of playful learning. These authors explicitly talk about playful learning and argue that playful learning should entail "where interaction with informational artefacts involves fun and where the boundaries between play and learning are blurred" (Price et al. 2003, p. 170). Fun, use of physical objects and social engagement are seen by Price et al. as fundamental aspects in playful learning and refer to Rogoff as one of the researchers who have demonstrated the benefits of collaboration among children during their learning process. In this respect I find that the work of Vygotsky, Rogoff and Wertsch can enable me to envision how MicroCulture could contribute to the social interaction emerging between children and guides during the guided tour.

I find that guided tours share concrete similarities with Rogoff's definition of apprenticeship in thinking (as argued in Paper 2), which builds on the studies conducted by Vygotsky and Wertsch on learning and mediated play. According to Rogoff (1990), children acquire new knowledge and skills by engaging in "goal-directed activities" together with adults and/or expert peers, who guide them through their learning process while pursuing a common goal. Goal-directed activities could be of any kind, instructional or non-instructional, such as food preparation or sports. They take place in social contexts and involve raw materials and a set of tools, which the children have to learn how to master. In apprenticeship in thinking, learning is analysed as a social mediated interaction[9] where learners and facilitators communicate with each other verbally and non-verbally through the artefacts involved in the performed activity. Facilitators, who are expert adults or peers, play a fundamental role in allowing children to face unknown tasks when reaching their "zone of proximal development," defined as the boundary between what is already mastered and what the children are able to learn, according to their cognitive development (Vygostky 1978, p. 87; Rogoff 1990, p. 14; Wertsch 1991, p. 28). Adults can support children in different ways, instructing them verbally and non-verbally, for instance demonstrating how to interact with tools and the environment. They can support the children also through forms of "distal arrangement" or responsibility transfer (Rogoff 1990, p. 93; Wertsch 1991), which enables the children to gradually gain independence and perform specific tasks without adults' guidance. Responsibility transfer provides the children with metacognitive support in the form of segmentation of the activity into simpler tasks and selection of proper tools (Rogoff 1990). This means that adults have the responsibility to understand when to guide and when to leave the children independent in mastering the activity on their own (Rogoff 1990), enabling them to develop further their skills and become more confident. Different attitudes towards facilitation can affect the learning process, so that adults who are more prone to transfer responsibilities to children allow the children to take initiative and become independent earlier, than adults who like to give guidance through the whole process[10] (Wertsch 1991; Rogoff 1990).

As Rogoff highlights the mutuality between the individual and the environment, she emphasises also the role of physical objects and of the environment as crucial to learning. In her studies, she especially mentions that children should learn how to master materials, tools, and features of the environment involved in the specific activity they are participating in (Rogoff 1995, p. 2; Rogoff 1990, p. 3-4 and 7). In this respect, Rogoff builds on Vygotsky and Wertsch, when discussing on the role of play in learning, Vygotsky (1978) argues that mediated play allows children to manipulate symbols, relate them to imagined situations, and reflect upon what could happen if a certain course of action was undertaken. In his work "Mind in Society" Vygotsky argues that "for children some objects can readily denote others, replacing them and becoming signs for them, and the degree of similarity between a plaything and the objects it denotes is unimportant. What

[9] The notion of mediated interaction is discussed more in details in the following sub-section and in Paper 3.

[10] This aspect is discussed in relation to the results from the final evaluations in chapter 7, section 7.3 and in Paper 4 and in Marchetti and Petersson Brooks 2013.

is most important is the utilization of the plaything and the possibility of executing a representational gesture with it. This is the key to the entire symbolic function of children's play" (Vygotsky 1978, p. 108). I find that in the mentioned passage Vygotsky emphasises the use of objects in supporting children's expression and development of their symbolic faculties, as Vygtosky's "playthings", which are physical toys or other objects used in play, can assume different symbolic meanings determined by the children's imagination. From Vygotsky's perspective children's play can be seen as a "complex system of "speech" through gestures, that communicate and indicate the meaning of playthings" among the participants (Vygotsky 1978, p. 109). This means that according to Vygotsky mediated play allows children to manipulate symbols, relate them to imagined situations, and reflect upon what could happen if a certain course of action was undertaken. In so doing, children lift their thinking ability from a concrete level, which relates to the material context the children are experiencing in their present unit of time, to an abstract level projected towards imagination, conceptual speculations, analysis, and problem solving. It is in this respect that Vygotsky lays the foundation of playful learning as it is discussed in existing literature (DeVane and Squire 2012; Resnick 2004; Price et al 2003).

Similarly Wertsch explores the relation between play and learning in his reflections on the role of mediation of physical objects in learning, which constitutes a fundamental aspect in playful learning, as according to Price et al. (2003). According to Wertsch, physical objects are seen as "mediational means" in knowledge transfer (Wertsch 1991, p. 119), enabling individuals to achieve a shared understanding, like the boundary objects defined by Star and Griesemer (1989). Hence, in my analysis of guided tours examples of meditational means include ancient artefacts as well as available tangible and digital exhibits displayed in museums. In solitary as well as social conditions, mediated play can take the form of a theatrical improvisation or role-play, intended as the experiential creation of a narrative, in which players act as characters and narrators (Hallam and Ingold 2008; Sutton-Smith 1997). The emergence of role-play could be related to participation in and exploration of novel situations (Robinson 1977; Sutton-Smith 1967) where children start asking, "What can this object do?", while in familiar situations children would ask, "What can I do with this object?". In this way, children experience expressions and actions as sensations, defining and enacting imaginary situations by manipulating physical objects (Petersson and Brooks 2006). Moreover, play has also been described as a transaction between the individual and the environment, creating situations that are intrinsically motivated, internally controlled, and free of constraints from the objective reality (Petersson 2006; Bundy 1997). In this sense, play consists of a variety of activities that involve mediation, intended as a manipulation of the environment and of objects embodying symbolic meanings (Vygotsky 1978), mediating between reality and hypothetical situations.

Applying these perspectives to the guided tours for young visitors as the main unit of analysis of this study I find that the concept of mediation, as it was defined by Wertsch based on Vygotsky, emerges as central in relation to social interaction, learning, and use of the physical environment of the museum. I, therefore, argue that guided tours can be defined as mediated practices in the terms of Wertsch (1991, p. 119), in which the artefacts displayed in museums play the role of "mediational means" in knowledge transfer. The perspective proposed by Wertsch is in line with the study conducted by Star and Griesemer (1989), which discusses the role of the displayed artefacts in museum learning practice as "boundary objects." According to Star and Griesemer, when people communicate with each other, the objects they use or that are around them become an essential part of their communication, facilitating the emergence of a shared understanding among people who have different backgrounds. I have identified similar claims also in museum studies, like Crowley and Jacobs (2005) and Pierroux (2010), who argue that museum learning practice takes place through the mediational meaning of artefacts and reconstructions, as well as visitors' interpretations on those artefacts (Pierroux 2010), as guides talk to the visitors addressing specific artefacts and their meaning.

This thesis builds on the notion of mediational means and boundary objects as a fundamental component of playful learning. I find these perspectives relevant to investigate this sub-question, in particular to analyse the role of digital exhibits within guided tours and to investigate how guides and children interact currently with each other when engaged in guided tours.

Later in the thesis in analysing how some children played during the design workshops (chapter 6, section 6.3) I introduce the concept of playful play, which was proposed by Sutton-Smith (1997) to discuss a particular form of play expressed by highly creative individuals. In playful play children enjoy themselves in creating new physical toys and rules of play for other children to play and not for themselves. This particular form of play can be analysed as a specific instance of mediated play and it was expressed by a group of children during the participatory workshops, which are discussed further in chapter 6, section 6.3.

Recalling the theories discussed in this section and related work discussed in chapter 2, forms of mediated play could contribute to enrich guided tours. As detailed in Paper 2 and 4, a playful learning approach could introduce a framework for children and adults to participate on equal foot in cooperation and problem solving, similarly to other studies in interaction design (Muise and Wakkary 2010). In this sense, I see mediated play as an important component of playful learning, offering support for: conceptual thinking and understanding of the learning content (Vygotsky 1978). In a playful learning scenario mediated play is seen in this thesis as a resource to enrich guided tours eliciting forms of conceptual thinking in the children. As according to Vygotsky and Wertsch, mediated play enables children to engage in conceptual thinking exploring the meaning embodied in the objects themselves. Hence, it is expected that by introducing forms of mediated play, the children will engage in reflecting on which actions to take in the game and the consequences of such actions, imagining how it could have felt to live in the Viking Age. Second mediated play is seen as a resource for communication and mediation between the children and the guides as according to the notion of mediated action (Wertsch 1991) and apprenticeship in thinking discussed (Rogoff 1990). According to Wertsch and Rogoff, physical objects enable children and their facilitators to communicate and share knowledge. In this sense, a playful learning approach leveraging on mediated play is seen in this thesis as better supporting learners and their facilitators in achieving a shared understanding on a specific topic, despite their different backgrounds and interests. Finally mediated play is seen as a resource for the empowerment of learners in relation to responsibility transfer and children's freedom of choosing different courses of actions (Wertsch 1991; Rogoff 1990). More specifically mediated play is seen as a transaction between learners and their facilitators, and their environment, creating space for intrinsically motivated situations for the participants. Hence, the adoption of playful learning in guided tours is expected to support the emergence of intrinsically motivated courses of actions and individual empowerment for the children participating in guided tours. In this way, children should be able to make active use of guidance, as envisioned in Rogoff (1990), communicating their needs to the guides. In this respect, the adoption of a playful learning approach to guided tours is seen as creating conditions for responsibility transfer, introducing space for negotiation about guidance and independence between children and guides.

In conclusion, starting from the problem of the digitisation of guided tours, mediated play in playful learning is identified as a meaningful pedagogical perspective to reconfigure meditation during guided tours, turning young visitors into active learners. In this respect I have identified specific requirements for the design of MicroCulture. First of all MicroCulture should support the introduction of one or more goal-directed activities involving forms of social mediated play and problem solving, in which children and guides could participate together, in line with current studies like Apostolellis and Bowman (2015) or Lyons et al. (2015). Second the guides should be able to use MicroCulture as a demonstration tool, enabling them to discuss historical knowledge in more concrete ways. This requirement is line with Lyons et al. (2015), who investigated how "to align the affordances of their technologies with the learning content and the activities they are

trying to support" (Lyons et al. 2015, p. 49). Third the design of MicroCulture should aim at creating a meditational mean, in the terms of Wertsch, facilitating responsibility transfer, which is acknowledged by Rogoff as a fundamental aspect of apprenticeship. In this respect the design process should take into account the guides' attitudes towards responsibility transfer and create conditions for children to freely explore how to play (this aspect is discussed further in Paper 3). Finally, in line with Vygotsky MicroCulture should embody symbolic meaning related to historical knowledge, so that the children should be able to engage naturally in abstract thinking and conversations about the historical knowledge that they are supposed to acquire.

3.4 Digital technologies as means to represent history as a social process

In this thesis, digital technologies are considered meaningful within museum learning practice when they contribute to learning. This study explores specifically how digital technologies can enhance learning of history, representing history as a social process. The aim is to enable the visitors to gain an understanding of history, from the perspective of change and social relations among the humans involved. Therefore, this section presents theoretical perspectives, with focus on Carr (2001), highlighting which factors could be considered in the design of digital technologies aimed at supporting the learning of history inside the museum. These theoretical perspectives provide meaningful insights to address my last sub-question, enabling me to define what historical knowledge is and how it could be represented in a digital exhibit targeting learning.

From a theoretical perspective, historical facts are problematic, as their definition depends on the historian's subjective interpretation and their emergence results from the unpredictable result of sociocultural processes. Not all facts from the past are historical facts or are recognised as such by historians. Historical facts can be regarded as "basic facts" acknowledged by all historians, such as the fact that "the battle of Hastings was fought in 1066" (Carr 2001, p. 10). However, the definition of historical facts depends on the individuals who were involved, for instance historians regard Cesar's crossing of the Rubicon as a fact of history, whereas the same historians neglect the crossing of the Rubicon by millions of other people (Carr 2001). In this respect, historians contribute to the making of a historical fact as well as the people who experienced it in the past. As a result, "the history we read (...) though based on facts, is, strictly speaking, not factual at all, but a series of accepted judgements" (Carr 2001, p. 14; Barraclough 1955, p. 14). Such argument disproves the belief of historical facts as existing objectively and independently of the subjective interpretations of historians.

I find that this argument is in line with recent studies investigating the role of museums in contributing to the making of historical facts such as Lischke et al. (2014), Iversen and Smith (2012), Ciolfi (2012), and Schofield (2002). These studies more or less explicitly acknowledge the active role of museums in the creation of historical facts. The first three studies propose a scenario, in which digital technologies are seen as means for the museums to share ownership in curatorial practice, in this way they are in fact proposing a democratisation of the process through which museums contributed to the creation of historical facts, that is through the creation of exhibitions as it is specifically discussed in Schofield (2002). In the context of this thesis, I argue that the nature of historical facts has implications for museum learning practice and affects the museum practitioners' freedom in planning exhibition, in interpreting historical facts, and in deciding the content of the guided tour. Like historians, museums contribute to the interpretation of historical facts, as by selecting which artefacts to display in their exhibitions Schofield (2002). They have the authority of deciding what should be remembered and

acknowledged as cultural knowledge for society as a whole. Those artefacts that are not shown by museums are forgotten and their cultural meaning neglected, because their story will not be told (Schofield 2002). However, when considering guided tours addressed to primary school pupils, museums have to present historical facts and artefacts according to the interpretation officially acknowledged by the school system (Reeve 2006).

The layout in which artefacts are displayed is also part of the process of history making. The spatial mapping created for an exhibition can in fact suggest misleading meanings about the displayed artefacts, such as wrong chronology or cultural values related to the artefacts morphology or use. An interesting example is discussed by Fienup-Riordan (1999), who reported a case about the planning of an exhibition about Yup'ik Eskimo ritual masks from Western Alaska. In the discussed case, the author and museum practitioners from different institutions agreed on displaying Yup'ik masks focusing on their morphological similarities, so that the spatial mapping of the exhibition was focused on similarities in the look and materials of the different masks. However, representatives from Yup'ik tribes claimed that a spatial mapping based on morphological appearance would be misleading as these masks have specific ritual meanings in relation to the values of the tribes who made them, while their visual similarities were merely accidental. Therefore, it was decided to display the masks in relation to their geographical provenance. This case represents an example of how spatial mapping participates in creating and communicating meaning to the visitors. As a consequence, it becomes an important factor to consider in design practice, as newly created digital exhibits have to be included in the spatial mapping of an exhibition and contribute with coherent meaning.

Carr looks at history as a "social process, in which individuals are engaged as social beings" (Carr 2001, p. 49). The "facts" of history originate from the relations of different individuals with each other, within their society and from "social forces," which may produce results that are unexpected or even undesired by the individuals who were involved. Therefore, historians are concerned with analysing and "marshalling the events of the past in an orderly sequence of causes and effects" (Carr 2001, p. 88), providing various "explanations" or "interpretations."

This perspective on history emphasises sociocultural aspects and changes, and it can be found in the works of remarkable historians, such as: Huizinga (1937), Bloch (1990), and Le Goff (1990), who argued in favour of an anthropological perspective on history. In "The Waning of the Middle Ages," Huizinga (1937) proposes an innovative perspective on the study of cultural and social values in medieval life in France and The Netherlands, linking materiality, social relations, and culture. Through his book Huizinga develops different narrative threads, for instance he discusses Gothic culture establishing connections between social hierarchical structures, Gothic architecture, and the Gothic arts of windows and tracery. Another thread discussed by Huizinga is represented by the contrast between the lively colours of noblemen's clothes and the greyish-brownish peasants' clothes as a visible sign of their different status. These cases provide a rich cultural framework to talk about everyday life, material culture, and the historical events taking place at that time, aspects that could be considered when designing digital exhibits for historical museums.

Similar insights are proposed by Bloch in: "The Royal Touch: Monarchy and Miracles in France and England" (1990), where he discusses monarchy not from a factual political and economic perspective, but from the perspective of the social relations occurring between noblemen and peasants and how these relations affected the mind of the peasants eliciting superstitious beliefs. Bloch collected and analysed ancient written sources, testifying that in the Middle Ages, it was believed that the touch of a king could relieve peasants from diseases such as scrofula. As a result, this work reveales sociocultural meanings associated to how the peasants perceived the authority of their kings.

Bloch's student, Le Goff, emphasises long-term processes and the interplay between individuals and society, for instance, discussing the emergence of the intellectual as a professional figure in the context of medieval universities, in "Intellectuals in the Middle Ages" (1990). Hence these historians do not tell historical facts, but they tell stories about how people perceived and related to each other and their world. They provide a deeper understanding about what it meant to be a human being living in the past.

Summing up, the analysis of historical research and museum practice suggests that the design of digital exhibits aimed at enriching learning of history should take into account three main requirements, such as: to contributed to the spatial mapping of the exhibition layout, to represent historical facts emphasising change, in order to enable visitors to understand history as a social interplay between the individuals involved.

This study has, therefore, the ambition to enable children to experience what it meant to be involved in urban development during the Viking Age. In this way, young visitors are expected to better grasp the complex nature of the represented historical fact with respect to the social interplay among the individuals and the social forces involved, and their physical environment. From a theoretical perspective this study attempts to twist guided tours into a playful learning practice, introducing play as a goal-directed and non-instructional activity. In this thesis Wertsch's notion of mediational means is considered a central aspect of playful learning and a generalisation of the concept of boundary objects. The concept of boundary objects as defined by Star and Griesemer (1989) refers more specifically to the museum context, while Wertsch's (1991) concept of meditational means is referred more in general to learning contexts. From a practice-oriented perspective these concepts can be found useful when designing for learning and engagement in general, but they are not sufficient to find out how mediated play could support learning of history. Hence, the mentioned concepts are complemented by Carr's understanding of history as a social process, which provides insights about the nature of history and how it can be understood. Moreover, the studies conducted by Huizinga (1937), Bloch (1990), and LeGoff (1990) are seen as exemplars of how specific historical facts can be analysed from a social perspective. More details will be discussed in Chapter 6, which focuses on the development of the prototype.

4. Method

The empirical study discussed in this thesis has been conducted as a design-oriented research, which is defined as design practice aimed at the creation of a new knowledge contribution (Fallman 2003). For the design process undertaken in this study I have adopted a participatory design approach supported by qualitative methods such as ethnographic observations, situated interviews and interaction analysis on video recordings. Participatory design was chosen as it enables the designers to get rich insights about the needs of the users and new inspirations by sharing ownership with them on the design of new technologies, as shown in related work (Iversen and Smith 2012). Participatory design was combined with qualitative ethnographic methods because these enable the researcher in understanding human activities, analysing the details of social interaction also supported by technologies (Jordan and Henderson 1995), which is the main topic of this study. At the same time my study is following the approach that Rogoff (1995) recommends in her analysis of sociocultural activity, where she advocates for choosing a main activity as unit of analysis (in line with Vygotsky 1978), and for the adoption of ethnographic (participant) observations and situated interviews while the activity at hand is taking place. The same approach is also applied in the few studies addressing the guided tours like Best (2012) and Pierroux (2010). Finally I have chosen to combine participatory design and ethnographic methods in analogy with current studies addressing the design of new digital exhibits (Dindler et al. 2010; Iversen and Smith 2012; Ciolfi 2012, Hall and Bannon 2005).

In order to place the contributions proposed by this thesis, this chapter discusses the methods that are applied to my empirical study, reflecting on how my study relates to the notion of design-oriented research and its methodological implications. Hence, section (4.1) discusses existing theories about design-oriented research, section (4.2) presents more specifically the methodological choices and procedures adopted in the empirical study regarding: target groups and context, ethics, and the different stages of the study.

4.1 Design-oriented research

The study discussed in this thesis is a qualitative design-oriented research (Fallman 2003), in this sense, the theoretical insights and the empirical results gained from the final evaluation of the prototype cannot be generalised to other studies conducted in different contexts and involving different individuals, without an adequate recontextualisation. As emphasised by Rittel and Webber (1973) and Simon (1996), it has to be accepted that the solutions and results gained from design interventions do not have universal validity per se, but are dependent on the different factors involved in the problem investigated. These factors include the physical environment, the individuals and other contingencies related to the available resources. In this respect, the notion that a technology works when the right person is behind it (Petersson 2006) acquires new methodological values, implying that evaluations of the same prototype conducted by the different researchers and with different subjects can produce different and unpredictable outcomes. This means that this thesis does not attempt to provide undisputable data, but rich insights and a new framework that can be applied to other studies, only if supported by a critical reframing.

In the following sections, the methodological framework of this thesis is discussed in relation to the notion of design-oriented research (4.1.1), how the design process has been framed in order to contribute to museum learning practice (4.1.2) and what are the methodological implications

of this framing for the study (4.1.3). In the end (4.1.4), participatory design is discussed as the specific method adopted in the empirical study.

4.1.1 Design practice and design-oriented research.

The relationship between design and research is ambiguous and many definitions have been proposed to clarify how design research should be conducted in order to produce meaningful theoretical results.

Researchers like Simon (1996[11]) and Cross (2006[12]) claim that design has to be regarded as a discipline in its own right, different from natural and social sciences. Simon defines design as "the science of the artificial" (Simon 1996, p. 111-113), where the word artificial refers to human made artefacts, opposed to natural sciences, which are targeted at the study of natural objects. Similarly, Cross defines design as "the third culture" in opposition to the more recognised disciplines of sciences, arts and humanities (Cross 2006, p. 1). Design is, according to both authors, characterised by the creation of material artefacts. Quoting the "Royal College of Art Report" from 1979, Cross claims that the central concern of design is "the conception and realisation of new things (…), it encompasses the appreciation of material culture and the application of the arts of planning, inventing, making and doing" (Cross 2006, p. 1). In this respect, design has its own "things" to know, ways of searching about them, and knowing them (Cross 2006). The same is acknowledged by Simon (1996), who claims that design is at the core of professional training concerned with the creation of artefacts in order to solve specific problems. In other words, Simon distinguishes between natural sciences and design as being respectively concerned with the discovery of things existing in nature and with human invention of new things. This means that design can be a practice for making artefacts but also a practice for making new knowledge related to the making of artefacts.

Frayling (1993) is particularly concerned with distinguishing between design and art practice from art and design research. He identifies three possible relations between research and art and design:

- Research into art and design;
- Research through art and design;
- Research for art and design.

According to Frayling (1993, p. 5), research into art and design is the most straightforward practice, as it is traditionally acknowledged by arts and humanities. It is concerned with theoretical perspectives such as: history, perception, ethics, economy, and culture. Research through design is less straightforward and less acknowledged in the research community. This form of research is characterised by seeking knowledge through the making of artefacts, exploring materials, process of development, and/or practical experiments. Finally, research for art and design refers to the research conducted with the goal of creating artistic or design

11 It is referred to the third edition of *The Sciences of the Artificial*, the first edition was published in 1969.

12 It is referred to a late edition of *Designerly ways of knowing*, the first edition was published in 1942.

artefacts. For instance, the studies conducted by Constable on the formation of clouds to paint more beautiful and realistic landscapes, fall in this last category (Frayling 1993).

Richer perspectives on the relationship between design and research have been proposed by the studies of Fallman (2003) and Zimmerman et al. (2007). Fallman is concerned with the role of design within research practice. Design is characterised by "an attitude of making" where the researcher is supposed to create and give form "to something that was not previously there" (Fallman 2003, p. 225). In this aspect, Fallman's perspective is not distant from Simon and his notion of design as the culture of human invention. However, Fallman is critical of Simon's goal of creating a "science of design" (Fallman 2003, p. 228). According to Simon, this science of design should be "analytic, partly formalizable, partly empirical, teachable doctrine about the design process" (Simon 1996, p. 56). Fallman argues that in his definition of design as a science, Simon is still attached to the natural sciences, while design has limitations in the way it can resemble other sciences. The main difference between design and sciences is that two designers facing the same problem will not find the same solution. Moreover, the design process cannot be transparent in the same way an experiment can, as there are limits in the way designers can conform to prescribed behaviour and their knowledge is hard to articulate. In this respect, the notion of design-oriented research defined by Fallman is in line with Frayling's notion of research through design, in which new knowledge is investigated through the making of new artefacts.

Zimmerman et al. (2007) are concerned with the creation of a new model to formalise research through design as a legitimate method for research in the field of Human Computer Interaction (HCI). Zimmerman et al. provide two contributions: a new model targeted at the HCI community and a set of criteria for evaluating the quality of interaction design contribution. This model uses the terms research through design (as in Frayling), where design is defined in this model as an activity aimed at transforming "the world from its current state to a preferred state" (Zimmerman et al. 2007, p. 1). The design artefacts become "design exemplars, providing an appropriate conduit for research findings to easily transfer to the HCI research and practice communities" (Zimmerman et al. 2007, p. 1). This means that this model proposes to conduct design oriented inquiry, combining theories from HCI with theories from the addressed practice. In this way, the model is defined as a holistic "method of inquiry" to address "under-constrained problems" (Zimmerman et al. 2007, p. 1) or as these are called by Rittel and Webber (1973, p. 160) "wicked problems." Wicked problems come from the real world; they are ill defined and require a complex process of analysis to be understood and eventually solved. Moreover, because of their under-constrained nature, wicked problems are unlikely to be solved in optimal ways. Therefore, as argued by Simon (1996), the designer must be contented with providing partial and imperfect solutions.

The notions of design-oriented research and research through design are seen as equivalent for the scope of this thesis, as they are both concerned with seeking new knowledge through the making of new artefacts. These notions are central to the study discussed in this thesis, which aims at seeking knowledge about the wicked problem of the digitisation of museum learning practice through a design intervention. The design outcome, MicroCulture, is regarded as an exemplar, embodying research findings to be communicated to the interested research communities in line with Zimmerman et al. (2007, p. 1). On the other hand, since this study aims at producing a change in museum learning practice, not only the HCI community needs to be addressed, but also communities dealing with learning and museum studies. Therefore, this thesis combines interaction design studies with sociocultural and museum studies, arguing in agreement with Zimmerman et al. (2007) that a holistic approach is required, unifying technical opportunities with theories about human behaviour.

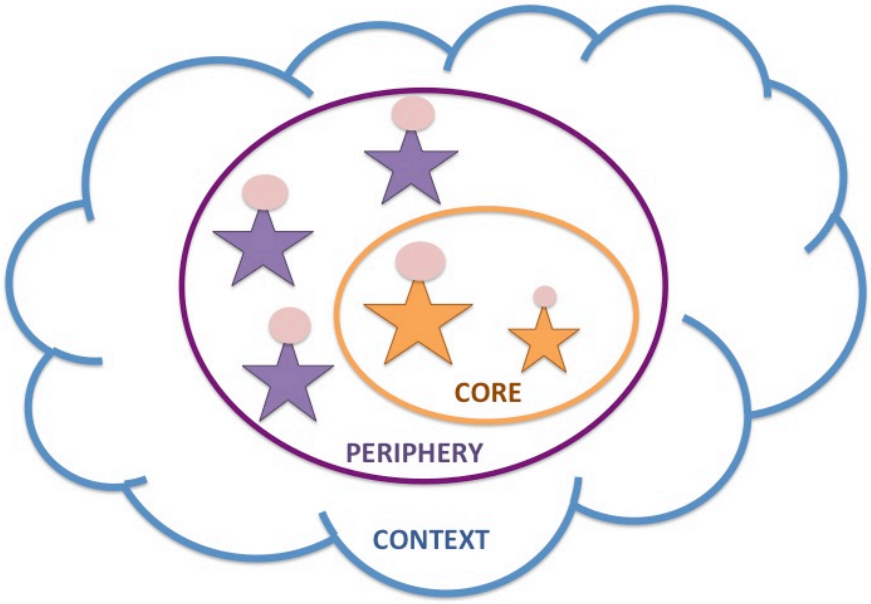

Figure 4. Three circles model, after Löwgren and Stolterman (2004, p. 33).

4.1.2 Museum learning practice as a sociocultural activity

Simon (1996) discusses human made artefacts as interfaces, whose inner environment, constituted by its substance and organisation, has to be compatible with the organisation and substance of the outer environment in which the artefact has to operate.

In the situation discussed in this thesis, learning technologies can be seen as interfaces between their inner environment, which includes their features and the values embodied in their conceptualisation and interaction modalities, and the outer environment of learners and facilitators, constituted by their distinctive values and goals. The adoption of this understanding of learning technologies demands for an inclusive or holistic perspective, as argued by Zimmerman et al. (2007), in order to create an outcome that fits within the context in which it has to operate. A similar perspective is also proposed by the mentioned study of Ciolfi (2012) and targeting explicitly the study of museums.

However, the application of Zimmerman's model does not seem sufficient to the study of the digitisation of museum learning practice, in particular concerning the macro level discourse. This model in fact proposes to exclude from the design process financial and administrative matters that are central to the shift in the role of museums. As a consequence, this thesis extends the holistic model proposed by Zimmerman et al. in order to include the practical factors (administrative, financial, and organisational) that affect museum future investments for the acquisition of new tools. In this respect, the three circles model defined by Löwgren and Stolterman (2004) can better support the inclusion and prioritisation of practical factors involved in museum learning practice complementing Rogoff's three planes, in order to bridge between macro and micro discourses. Löwgren and Stolterman claim that design is also a management challenge, in which the designer has to decide how the different users and clients will be affected by the final outcome and plan the design process accordingly. Hence the two authors introduce "a three-layered structure" in order to analyse the design situation and sort the different users or

clients in relation to their different levels of involvement (Löwgren and Stolterman 2004, p. 33). In the core circle, the designer, users, and clients are directly involved in the process (Fig. 4). At the periphery, users and/or clients not directly involved in the process are to be found. Finally, In the context circle, the surrounding environment and society is located, which are not directly involved but, as explained by Löwgren and Stolterman (2004, p. 33), "still influence it in indirect and complex ways." I see the three circles model as complementing Rogoff's three planes, enabling the designers to make decisions on the involvement of users in the design process in relation to how directly they will be affected by the design outcome. Analysing the specific case of this thesis through the three circles model, guides and visitors would be in the core circle, as they directly participate in guided tours and will be directly affected by the newly developed technology. Curators and other practitioners, who are not directly involved in guided tours, would be positioned in the periphery circle, while the shift in the role of museums and the external institutions involved would be positioned in the context circle, as discussed in section 4.2.1.

Significant differences can be found between Rogoff's three planes and the three circles model, as the three circles model is intended as an aid for designers to structure their design process in relation to which users will be most affected by the design outcome. Rogoff's planes are instead aimed at analysing learning as a process embodied in a specific sociocultural context. Moreover, Rogoff's planes are defined with respect to learners' own perspective on their own process. In this respect Rogoff's (1995) three planes (personal, interpersonal, community) and the three circles of Löwgren and Stolterman provide complementary support to this study, as Rogoff's planes supported me in understanding museum learning practice as a sociocultural activity and how this activity is affected by the shift in the role of museums. With this in mind, the three circles model enabled me to decide upon how to involve the users in my design process. In this sense, Rogoff's studies in sociocultural activity provide support to refine existing design models to make them more suitable to study museum learning practice from a holistic/inclusive perspective addressing: visitors, practitioners, and the museums as institutions participating in the development of younger citizens.

Furthermore, in line with Rogoff (1990), this thesis builds on the assumption that children learn by taking part in routine or tacit activities as well as explicit collaborations with other children and adults. Participating in such activities children become prepared to actively participate in similar activities in the future (Rogoff 1995). In this way, a reformulation occurs in "the relation between the individual and the social and cultural environments in which each is inherently involved in the others' definition. None exists separately." (Rogoff 1995). In other words, Rogoff argues that in learning the individual, the social, and the cultural environment are entangled, so that it would be pointless to study learning as an isolated process that only involves an individual, as the social and the environment participate in affecting the individuals involved and their knowledge. At the same time, the individuals involved participate in reformulating the social and cultural environment. Similarly, children visiting museums do not learn as isolated individuals, but as part of a group, either their families (Hornecker and Stifter 2006; Muise and Wakkary 2010), or their classmates while taking part in a guided tour (Best 2012; Pierroux 2010). Moreover, the museum is a rich cultural environment in which learning takes place through interactions with the environment itself, the artefacts displayed, and adult experts like the guides. The relation between these elements and actors is reformulated through the learning process, when children and adults interact with each other through the museum environment. At the same time, the introduction of new learning materials within museum space creates conditions for a critical reformulation of the mentioned elements, affecting how the environment should be used in learning (Säljö 2010; de Freitas and Oliver 2005). Building on these reflections, it became important for me to address these questions:

1. How do children engage in learning with other children and adults when entering the museum space?
2. Which activities do children participate in and how do such activities affect them?
3. How would children like to engage in learning?

By addressing these questions, a more precise framework can be defined in relation to which sociocultural factors should be considered in the design of new technologies for museum learning practice and design goals. The role of technologies should be investigated, therefore, not only in relation to the individual visitor, but also in relation to the museum context and the activities that normally take place at its inside.

Following the studies of Rogoff (1995, 1990) and Vygotsky (1978), it became necessary to identify a specific activity, which could serve as a unit of analysis as well as an exemplar of the practices typically taking place in museums. By systematically studying this activity, it is possible to investigate how children engage in learning with their mates or adults and what are the challenges and dilemmas in their current learning experience. In this particular case, guided tours emerge as an interesting unit of analysis. Guided tours are common in different countries, they represent often children's first experience of museum, and they have not been deeply investigated neither in design nor museum studies (Best 2012). Moreover, combining the perspectives provided by Simon (1996) and Rogoff (1990), guided tours appear as a sociocultural activity emerging from the intertwining of the individual, the sociocultural context, and the physical environment in which it takes place. A meaningful design intervention should allow to reflect upon how new digital exhibits can alter the sociocultural context and physical environment of guided tours, hence reformulating the roles and relations between visitors and guides. In methodological terms, this means that guided tours will have to be studied in its usual context, through a situated approach and actively involving key participants.

4.1.3 Methods adopted in the empirical study

Building on this sociocultural/design-oriented grounding, an ethnographic-participatory inquiry has been conducted involving a participatory design process (Druin 2002), supported by (participant) ethnographic observations, semi-structured and situated interviews (Pink 2007), and interaction analysis (Jordan and Henderson 1995). Each session involving users during the field study, design process, and evaluation, has been video-recorded (once users' permission was granted[13]) in order to support iterative analysis through time and to achieve a spontaneous conversation flow during interviews, which could have been disrupted by an excessive annotating activity. This mixed approach is aimed at achieving reliable data and in-depth reflections through a methodological triangulation (Casey and Murphy 2009; Silverman 2005). Hence each stage of the empirical study occurred in four main steps:

1. Observations, recording, and annotation in the field;
2. Reflection on notes and clustering;
3. Analysis of videos and new annotations;

[13] See section 4.2.2 Ethics, in this chapter.

4. Final clustering.

The first step was aimed at gathering empirical data to analyse through video recording and observations. Therefore, according to the method of visual ethnography and interaction analysis (Pink 2007; Jordan and Henderson 1995), each session involving users was observed and filmed, while selective notes were taken in relation to key occurrences that could lead towards learning, empowerment, and design guidelines. In the second step (reflection), the gathered notes were then analysed later so to create clusters of meaning related to occurrences in the participants' interactions (Preece et al. 2011), with respect to the mentioned three criteria. In the third step (analysis), the gathered video material was analysed through interaction analysis (Jordan and Henderson 1995), so that users' behaviour and responses to the technologies were observed and interpreted with the same three criteria. Selective transcriptions were taken on a separate text file and associated to specific screenshots. In the end (fourth step-final clustering), the notes from observations and video analysis were compared, so to create a final cluster enabling me to identify how the technologies affected the participants during the activities carried out and new design opportunities.

Methodological decisions are a complex process as each method is suitable to specific situations and meanings, but has distinctive weaknesses. For instance, different forms of interviews can be used to investigate how people describe their world from a conscious level of experience (Silverman 2005), how they personally relate, rationalise, and remember what they do. But there are things that belong to an unconscious level of experience or that people do not consider worth mentioning in an interview, such as tacit routine practices. In these cases, ethnographic observations provide a better support, enabling the researchers to observe the richness of people's actions in specific situations, uncovering tacit routines and emergent interaction, grounded in the environment in which they take place. On the contrary, observations are suitable only to a limited extent to find out how people relate to their actions, their reasons, and motivations behind them (Silverman 2005). In this sense, a methodological triangulation can be used to explore different perspectives and gain richer data on a specific design problem (Preece et al. 2011; Jupp 2006). However, methodological triangulations can be risky too, as the combination of different data gathering techniques can provide incompatible data, leading towards incoherent results. This could happen for instance when combining data gained through qualitative and quantitative methods, which are based on different philosophical perspectives about science (Preece et al. 2011). To avoid potential issues, the methodological framework of this study is grounded on qualitative ethnographic methods, which build on the same philosophical assumptions and are generally adopted in sociocultural as well as participatory design studies.

Limitations were identified in the applications of quantitative methods, such as controlled experiments and measurements of user experience. Quantitative methods impose controls on the activity and its context in order to avoid any bias, for instance, arranging events in a facility lab and assigning specific tasks and time frames to the users (Tullis and Albert 2008); this, however, alters sociocultural activities, taking them out of context and imposing unnatural rhythms and courses of actions. So defined, these methods are based on philosophical principles that do not correspond to those of the theoretical framework of the study. For instance, Rogoff (1995) emphasises the need for studying sociocultural practices in context, observing the usual routines and the environments involved in the activity in focus. Moreover, the methodological structure of the study was also inspired by the related works in the area of interaction design and the study of guided tours, which are discussed in chapter 2 such as Best (2012) and Dindler and Iversen (2009). These works argue in favour of a situated qualitative approach, based on ethnographic observations of the users while engaging with the use or design of technologies.

4.1.4 Participatory design

The aim of this section is to provide a discussion about how methods were selected by the researcher to conduct the design intervention in Ribe and to address the research questions.

In order to gather reliable data about the users' perspective on museum learning practice, participatory design was selected as the main method to create a new digital exhibit. Participatory design is defined as a "set of theories, practices, and studies related to end users as full participants" in the design of software and hardware computer products (Muller and Druin 2003). Users are actively involved in providing insights about their experience, in developing low-fidelity prototypes, and in evaluating high-fidelity prototypes. Low-fidelity prototypes are designed with simple materials, like paper or cardboard, in order to show the concept to the users in an iterative series of evaluations without using a significant amount of resources (Preece et al. 2011). On the contrary, high-fidelity prototypes should be fully interactive to enable the users to experience how the finished product could be. High-fidelity prototypes require more time and financial resources; hence they are created and evaluated in the end of the design process (Preece et al. 2011).

The overall goal of participatory design can be defined as democratising the development of human artefacts and related practices including users as co-designers (Bødker et al. 2000). Sanders (2002) proposes an interesting perspective, defining participatory design as a "shift in attitude from designing for users to designing with users" (Sanders 2002, p. 1). According to Sanders, this shift requires a different way "of thinking, feeling, and working" as participatory design is not just a set of methods, but rather a different "mindset and attitude to people" (Sanders 2002, p. 1). In this sense, the application of participatory design is mostly defined by how the designers relate to the users; this, in turn, will affect designers' understanding of the available participatory methods and the theoretical grounding of the project at hand.

In general, co-design practice is a central principle in participatory design methods because it enables designers to actively involve users in the process as much as possible on equal footing to the designers, as shown also by the methodological studies presented in chapter 2 (Dindler et al. 2010; Hall and Bannon 2005). In this respect I find that participatory design, complemented with interviews and ethnographic observations, is a promising method to investigate my research questions

However, the notion of involving users on equal footing can be complex and not totally straightforward. The researcher is in fact entitled to have a vision and specific goals for the design outcome, so that in the end, the input from users is evaluated and selected according to these visions and goals. Issues may emerge in relation to how the selection is made from the rich input provided by the users, especially when addressing groups of users, such as children and guides, as both groups are affected by the design outcome but have different needs, from which designers must select and integrate into the making of one prototype. Druin (2002, p. 4), analysing how children can be involved within a design process, has identified four possible roles, such as: "user, tester, informant, or design partner". According to Druin, children can act as users contributing to the research and development process by using existing technology, while adults may observe, videotape, or test for skills. Children can also act as testers when they test prototypes of technologies that have not been released as final products yet. Children can act as informant when asked to provide input on design sketches or low-fidelity prototypes. Finally, children can act as design partners when they are included and actively contributing to the process: "equal stakeholders in the design of new technologies throughout the whole experience" (Druin 2002, p.

4).

In the case of this thesis, children are regarded as end-users of the new exhibit and of museum learning practice, as they are supposed to learn by interacting with the prototype and taking part to guided tours. On the other hand, the guides are supposed to facilitate the children through the guided tour and also in the use of the design outcome. Moreover, guides have expressed the desire of eliciting active participation in the children, so to engage them in an interactive storytelling activity[14]. Taking into account these aspects, it was decided that children would be involved in the process as design partners or co-designers. Hence, they were asked to provide inspiration to the making of artefacts and to introduce changes to the prototype, according to their individual and shared needs (see section 6.4 Design Process). The guides were instead involved as informants in iterative testing (Druin 1999). This means that only the children were involved on equal-footing as design partners, taking critical decisions together with me about the features of the new exhibit (Druin 1999, p. 593). Through this differentiated involvement of users in the participatory design process, it was possible to investigate the second and third research sub-question, dealing respectively with how can digital technologies contribute to the practice of guided tours and with how can a digital exhibit enrich learning of history inside the museum. More specifically observations during guided and free tours, interviews and prototyping workshops with the children can enable me to uncover how they perceive the museum space and learning practice, their expectations and desires about museums, what is that they like or dislike and what is about history that interests them or not. On the other hand, observations and interviews with the guides can enable me to find out about how they usually conduct guided tours, what are their goals and challenges in communicating with children about history, and their desires or doubts about how they can envision the role of digital technologies in their daily work.

Ethnography is defined as a set of methods of inquiry originated in the field of anthropology. Ethnographic methods are aimed at gathering rich contextualised data about human activities through observations, also in a participant form, situated interviews, and analysis of visual documentation in the form of still images or videos (Pink 2007). The application of ethnographic observations requires closely following an activity, looking at how the activity itself takes place in its context, and how the participants interact with each other. According to Kensing and Blomberg (1998, p. 176), ethnography is useful to discover the "unarticulated aspects" of human practice, which could be routine practices people are not aware of. However, in combination with situated interviews, an ethnographic study can also contribute to reveal the conscious level of practice. Situated interviews have to be conducted in context and even better while the activity is taking place. In this way, the context, the activity itself, and the related tools enable the interviewee to remember specific episodes or usual issues that could be addressed in the design process (Pink 2007; Yliriksu and Buur 2006). In the case of this study, the interviews were conducted in a semi-structured form (Silverman 2005) so that the interview started from a prewritten list of questions for the researcher to keep in mind which aspects should be investigated. The interviewee was allowed to bring in detailed examples and new threads of conversation, yet keeping focus on the research foci.

In the case of this thesis I decided to adopt a combination of interviews and ethnographic observations through all the stages of the empirical study. During the field study, observations were adopted because these can support uncovering tacit routine practices in line with Silverman (2005) Kensing and Blomberg (1998), for instance how guided tours take place, how guides and children participate in the practice and how they interact with each other and the available exhibits, gaining in this way knowledge that is relevant to address the second research sub-

[14] See chapter 5, section 5.2.

question. At the same time observations can also reveal how the guided tour supports the communication of historical knowledge between children and guides during the guided tours, but also between the museum and its community in curatorial practice, addressing in this way the third sub-question. Moreover, I have chosen to combine observations with interviews to better uncover the conscious level of practice, in line with Silverman (2005). For instance the use of interviews can support me in addressing the main research question, as through interviews museum practitioners could provide relevant insights about their perception of the on-going shift. Following Pink (2007) I find that conducting situated interviews during observations of the exhibitions could enable the practitioners to discuss how the shift is affecting their curatorial work, emergent challenges and strategies in dealing with political, financial, and administrative issues, and hopefully their desires regarding the use of digital technologies. In this way it should become clearer how the design of a digital exhibit could contribute to the on-going shift. These same data could also be analysed to uncover the sociocultural factors involved in curatorial and learning practice, the focus of the first sub-question, which is aimed at gaining an understanding of the on-going shift. Moreover, I expect that interviews together with the guides and situated interviews, during a re-enacted guided tour inside the museum space, will enable me to address the second sub-question and to find out about the guides' reasoning behind their routines and actions during the guided tours. Through interviews the guides could also tell me about their experience and perception of guided tours. During re-enacted guided tours the guides could also explain what are their goals and desires in relation to their practice, why they interact with the children in the way they do and how do they expect that the children will contribute to the practice. Moreover, these interviews could trigger memories of stories and past experiences. Similar data could also be relevant to address the first sub-question and uncover the sociocultural factors involved in guided tours, from the perspective of the guides. At the same time I have chosen to conduct interviews with the children, to find out about their perception of the museum space, guided tours, and learning of history. So that interviews with the children will enable me to uncover the sociocultural factors that come into play in the way children approach museum learning practice and the guided tours, addressing the first and second sub-questions. Moreover, observations and interviews conducted in the museums space and during prototyping workshops will also be relevant to address the last sub-question, enabling me to uncover how children experience current learning practice, what is that they find interesting or uninteresting when entering a historical museum, what is the historical knowledge that they have difficulty grasping, and finally how digital technology and play could help them in better grasping that knowledge.

Each session was video recorded and the gathered video material was analysed with the method of interaction analysis, an interdisciplinary method suitable to study various forms of human activities, also mediated by the use of artefacts and technologies, as well as verbal and non-verbal interaction. This method requires the use of field notes, photographs taken on the field, and video recordings. It is grounded on the assumption that knowledge and actions are "social in origin, use, and organisation and are situated in particular social and material ecologies" (Jordan and Henderson 1995, p. 41). The main purpose of interaction analysis is to investigate details of social interaction that naturally occur in space and time among members of communities of practice in order to identify how people make sense of each other, utilising the complex social and material world in which they operate (Jordan and Henderson 1995). Interaction analysis advocates for a situated approach in which data are gathered in the context in which a community of practice usually acts and not in scientific laboratories or ad hoc experimental settings.

I expect that the application of interaction analysis on the videos gathered during interviews and observations with the users will enable me to support the notes gathered in situ with the users, and also to verify my initial understandings with a thorough analysis of what the practitioners and children said, how they said it, and how they interacted with each other. At the same time the

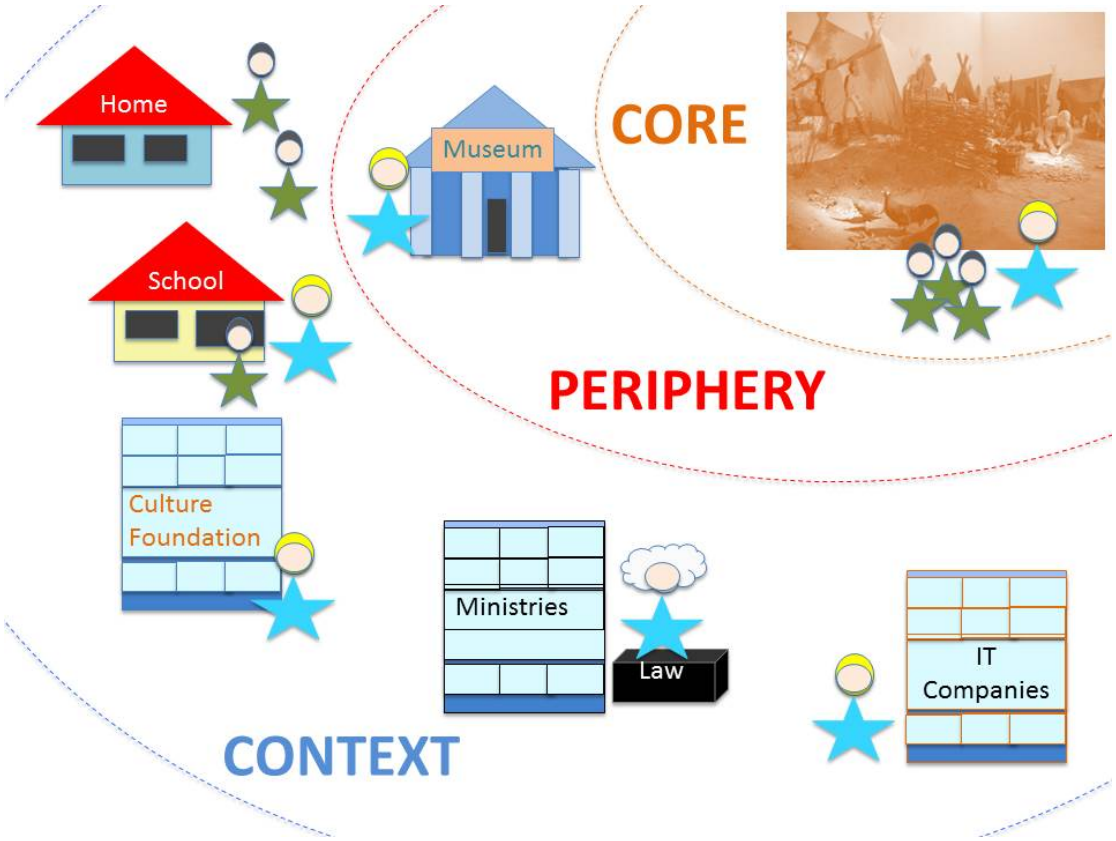

Figure 5. The three circles model applied to the study of museums, after Löwgren and Stolterman (2004). Guides and young visitors are located at the core, other museum practitioners at the periphery. External institutions involved in the shift in the role of museums constitute the context.

gathered video material can be used as documentation of the project and for further analysis during the process, in the eventuality that I might need to refresh my memory on the occurrences of a specific session, without having to force the users to recover their eventually lost memory.

Since this study aims at turning guided tours for young visitors into a playful apprenticeship, two contexts are involved: the museum as a sociocultural context for guided tours and children's usual contexts of play. Two museums were selected for this study, The Viking Museum in Ribe and the Transport Museum in Coventry, more details can be found in section 4.2.1, chapter 5, and Paper 1. Several contexts of children's playing habits have been considered to gather data about how children usually play and interact with each other, such as: private homes, libraries, which in Denmark offer playful activities to children, schools where children engage in learning and in play in their breaks, and afterschool institutions[15] where children play after their schoolwork. The afterschool institution was selected because therein, children can explore various possibilities for play and social interaction, together with adult pedagogues as well as other children of different ages. Afterschool institutions allow reaching large groups of children for each session, where they can vary in age and school experience. Involvement of mixed groups was expected to add richness to the study providing data about a broader spectrum of users in comparison to a study involving one school class where children have the same experience. Moreover, through the help of the pedagogues, it was possible to form a focus group and to

[15] In Danish these institutions are called SFO, acronym of *Skolefritidsordning*, literally meaning "organisation of free school time."

work in a structured, longitudinal way, which is required in order to pursue a systematic research study (Zimmerman et al. 2007).

4.2 The empirical study

The empirical study was structured according to the methodological considerations discussed in the previous section (4.1), in terms of user involvement and arrangement of co-design activities.

This section provides a critical account of how the empirical study was conducted, presenting the target group and context in the following sub-section (4.2.1), to continue with ethical considerations (4.2.2) and the different stages of the study in the last one (4.2.3).

4.2.1 Target group and context

Referring to the three circles model discussed above (section 4.1.2), the target group of this study includes young visitors and guides at the core of the design situation (Löwgren and Stolterman 2004) (Fig. 5), as they actively take part in guided tours and will have to interact with each other through the design outcome. Practitioners responsible for planning of exhibitions and of learning practices, such as curators and museologists are at the periphery of the design situation. These practitioners are not interacting directly with visitors and the design outcome, but they are responsible for deciding which resources and/or technologies to adopt. Finally, all the participants are affected by the external institutions participating in the on-going shift in the role of museums, which belong to the context circle.

The main target group is represented by primary school children around 10 years old, which is extended to a larger group of 9 to 12 years old for the final testing. This particular group was selected based on the preliminary survey conducted for the study (see chapter 4, section 4.2.3.1), suggesting that at that age children have experience of guided tours and might have their own opinion as well as the skills to discuss it with others (Markopoulos et al. 2008). Moreover, interviews with the guides revealed that although these children are perceived as "nice and polite" visitors, they do not speak directly nor ask any questions to the guides. This limited communication from the children's side prevents the guides from understanding how to properly support the children in their learning (as discussed in Paper 2).

Two local museums represent the main contexts of inquiry: The Viking Museum in Ribe (Denmark) and The Transport Museum in Coventry (UK). Practitioners from both museums were involved in the study. Table 1 below shows the list of participants and their institution of reference.

Table 1. List of participants to the study divided per institution of reference.

Institution of reference	Participants
Oksbøl (DK)	25 children 9-10 years old 1 Pedagogue

Viking Museum of Ribe (DK)	Curator, Head museologist, Guided tours coordinator, Two guides
The Transport Museum in Coventry (UK)	Curator, Head educator, Educator High school class Elementary school class

These museums were chosen because they share a focus on urban history and material culture (as discussed in Paper 1 and 2), they are both of a relatively small size, but are active in exploring new approaches to learning. Interestingly, many studies focus on national or large museum institutions, such as the Natural History Museum in Berlin (Hornecker 2008), the MoMA and the Philadelphia Museum of Art (Pierroux 2010). But local museums are more numerous and scattered through the entire country than national museums. For this reason, local museums can significantly contribute to the dissemination of knowledge within a national context, as it was attempted by the creation of regional hubs for museums in the UK (Hooper-Greenhill et al. 2004). Moreover, in local museums, the body of employees is significantly smaller than in national museums, allowing the researcher to get in touch with the key individuals pertaining learning practice and exhibition planning. Finally, small museums attract fewer visitors and have access to fewer funds than national museums, resulting in more challenges in managing the shift in the role of museums (Lang et al. 2006). Therefore, this thesis focuses on the reality of small local museums, similarly to studies such as Dindler et al. (2010), who cooperated with Moesgaard Museum in Aarhus and Hall and Bannon (2005), who cooperated with The Hunt Museum in Limerick (Ireland).

In this study, challenges emerged since the two museums involved operate in different sociocultural contexts and have different historical foci. The Danish museum focuses on the Viking, Middle Ages, and the Renaissance, the English museum focuses instead on more recent periods starting with the Victorian (1837-1901) and Edwardian times (1901-1914). Both museums deal with material culture and urban development, but the English museum is centred on local transportation industry. At first, it seemed that these differences could have enriched the theoretical perspective of the study and the creation of the inclusive perspective to support the design process. However, these differences have made it hard to design one single exhibit that could entirely fit the needs of both museums.

Reflecting on these difficulties, I decided to restrict the focus of the design process to the Danish context, because a closer contact was established with that museum; moreover, I could rely upon my knowledge of the literature about the Viking and Middle Ages due to prior experiences. But in order to respect the specificity of the two contexts, I also decided to prioritise shared interests and historical discourses, so that, on a general level, the design outcome could meet the needs of both museums. The risk of this approach would be to create an exhibit that is too generic to be able to support learning in a significant way.

More details about the design of the prototype will be discussed in chapter (6), Paper 2 and 3, which discusses the relation between the design of the prototype and museum learning practice.

4.2.2 Ethics

Designing with children can be a challenging practice, involving ethical issues in relation to the rights of the children and contingencies occurring during the design process.

One main issue is represented by the need to gain reliable data. This is required by several methodological approaches and implies that the researchers should not interfere with the subjects' actions (Silverman 2005). However, conflicts are an integral part of children's play, which involves exploration of social norms and reformulation of hierarchical relations (Sutton-Smith 1993). For instance, during a design session, a conflict emerged between a girl and other children, as she felt excluded by her group. As a result, I had to stop observing the other children and focus on the needs of a single individual. But after I joined her and encouraged her to play in her own way, the girl seemed to enjoy the co-design workshop and proposed new ideas for the prototype.

It is possible that the situation might have affected the reliability of the gathered data, as while playing with me, her input to the prototype might have been influenced by my ideas. In this respect, it is hard to evaluate the validity of the input provided by this child, hence, her input has been taken in consideration in comparison with suggestions from the other children.

This case shows that conducting a participatory inquiry with children requires a sensible reflection in action (Schön 1994), wherein the researcher engages in a reflective conversation with the design situation adapting to different occurrences not only from a creative perspective, but also from an ethical and emotional one, to show empathy to the individuals involved (Jönsson 2006). The triangulation between observations and analysis of video recordings was useful with respect to such occurrences, allowing to compensate for temporary lacks of attention to the other participants.

Finally, involving children in a design process implies ethical issues regarding the protection of their privacy, the use of their images, and gathering of information consent (Christians 2005). In this respect, I attempted to follow international policies with regards to children participation in research studies and respect of their rights. According to such policies, researchers should pay attention to ethical principles, which are listed here and detailed further below(Department of Children and Youth Affairs 2012, p. 1):

- Minimising risk of harm;
- Informed consent and assent;
- Confidentiality and anonymity.

A contact was established between the pedagogue of the afterschool institution and the parents of the children who participated in the study, so that both children and parents could be informed about the goals and procedures followed in the study. The contact with the parents is considered fundamental in research involving minors, who might not be mature enough to detect risks of harm (Cash et al. 2009). The pedagogue delivered to the parents a written form that described the procedure and goals of the study. The parents were asked to sign and return the

form if they agreed with allowing their children to participate in the study and in granting permission to the researcher to film the children and use their images for research and publication purposes. This means that the use of the children's images in this thesis was acknowledged and authorised by the parents of the children involved.

A dilemma emerged in the selection of images for publications in relation to the principles of protecting children's privacy and the one of accuracy (Christians 2005). This dilemma emerged in particular regarding Paper 3 and 4, which discuss data from the observations conducted with the children. According to the privacy principle, individuals should be anonymised, avoiding that even insiders could recognise the participants in an experiment. On the other end, for the accuracy principle (Christians 2005), it has become common practice in interaction design studies to present visual evidences proving that the data presented are genuine and not fabricated, as discussed in several methodological handbooks (Pink 2007; Yliriksu and Buur 2007). In order to deal with this dilemma, a few criteria were established for my study such as: to display only a limited number of pictures, to display pictures illustrating a particular situation instead of specific individuals, and not to show detailed images of the children's faces.

However, this dilemma between providing accurate documentation of the gained results and respecting individual privacy at the same time still remains a complex issue that each researcher has to deal with, according to the needs of the specific study and of the individuals involved. Some studies utilise drawings instead of pictures to document findings (Rogoff 1990), a strategy that could be adopted in future studies.

4.2.3 Stages of the study

This study is modelled according to Jones's (1963) tripartite structure including the stages of: "analysis, synthesis, and evaluation." These stages can be described as a process of: "breaking the problem into pieces, putting the pieces together in a new way, and testing to discover the consequences of putting the new pieces into practice" (Fallman 2003, p. 228; Jones 1963, p. 63). This means that this study started with a field study, in which the problem of the digitisation of museum learning practice was investigated in order to identify the users' needs and to formulate design requirements. Then, through the design process, low-fidelity prototypes were created together with the children in order to synthetise in one artefact the identified requirements and address the challenges related to museum learning practice as well as to the research questions. Finally, in the evaluation stage, I tested the high-fidelity prototypes in order to assess how these can affect museum learning practice and its participants, as formulated in the research questions.

This section briefly presents the three different stages of the study and how they were conducted, in order to inform the reader about how the final prototype was created and how the analysis of the gathered empirical data can help in addressing the research questions.

4.2.3.1 Field Study

Since before the official start of the study, a series of steps was made as part of the empirical work (Table 2). The first step included a literature review and a preliminary survey on local historical museums in order to support the completion of the project proposal. The survey focused on identifying how the layout of the exhibition facilitates the visitors in learning about history. During this stage, two interviews were conducted with the director and head museologist of South-West Jutland Museums, the organisation coordinating local museums in Southern

Jutland including the museum of Ribe, Denmark. These interviews focused on museum practitioners' perspective on: museum learning practice, young visitors, digital technologies, and the on-going shift.

Table 2. Description of the activities conducted with the users during the field study.

Participants	Date	Method	Context
Curator and Museologist From Ribe	Summer 2009 (Preliminary Survey)	Observation Interviews	Local museums: Ribe and Esbjerg, Den Gamle By in Aarhus, Fyrkat Viking Centre
Coordinator	13/10/10	Situated interview	Museum Ribe: café
Guide 1	13/10/10	Situated interview	Museum Ribe: Café, exhibition
Guided tour with a class of pupils from Ribe	13/10/10	Observation, video recording	Museum Ribe: exhibition
Guide 2	13/10/10	Situated interview	Museum Ribe: café, exhibitions
Children from afterschool in Oksbøl	15/10/10	Observation, task-based interview	Afterschool Oksbøl
Curator	22/11/10	Situated interview	Museum Ribe: office, exhibition
Children from afterschool in Oksbøl	24/11/10	Observation, task-interview	Museum Ribe: exhibition
Curator	15/12/10	Situated Interview	Museum Coventry: office
Head educator	15/12/10	Situated Interview	Museum Coventry: office, exhibition
Guided tour with a class of teenagers	17/03/11	Observation, pictures	Museum Coventry: exhibition
Educator	18/03/11	Situated Interview	Museum Coventry: exhibition
Workshop with younger pupils	18/03/11	Observation, pictures	Museum Coventry: museum workshop

The actual field study started with a set of situated interviews and observations[18] (Pink 2007, Yliriksu and Buur 2007) aimed at integrating practitioners and children's views on guided tours (see Table 2). All the interviews were filmed so that it could be possible to analyse the interviewees' verbal and non-verbal language (Pink 2007) and support further reflections through time. Both the preliminary survey and the field study were aimed at starting to explore the main research question and the first sub-question, identifying what sociocultural factors should be considered in order to contribute to museums learning practice also in relation to the on-going shift. The data gathered through these stages are expected to answer to the question of what designers and design researchers should know when dealing with museums.

Children's perspective on museum learning practice was investigated through three observations of guided tours in Denmark and in England. A task-based interview (Druin 2001; Rogers and Scaife 1999) was also conducted with a group of 10 years old children in Denmark (Fig. 6). Unfortunately, for practical reasons there were challenges in observing guided tours with the right target group. In Ribe, it was possible to observe a guided tour with a class of 10 years old and a free tour with the children participating in the design process. In Coventry, observations were run during a guided tour with a group of 14-15 years old and a workshop about urban traffic with 5-6 years old pupils. Interviews and observations of guided tours were aimed at addressing the second and third sub-questions, in order to gather data on how guided tours and learning of history take place and preliminary insights about how digital technologies could contribute to these practices.

A few issues emerged during these observations. Inside the museum, it was hard to closely follow the individual visitors, who were either packed within the limited available space or formed small groups scattered across the wider rooms, as mentioned in Paper 1. In this way, partial insights could be gathered on the visitors' actions and conversations. A lot of information was potentially lost and more structured methods of inquiry, such as conversation analysis had to be discarded as these methods required accurate transcription of what was said and how (Silverman 2005). Interaction analysis on video material contributed to enrich the analysis of these partial data, allowing to integrate verbal and non-verbal discourse and to create a meaningful clustering of the participants' behaviour.

Furthermore, during group interviews the children influenced each other in recollecting memories. A detailed conversation started, but it was not always clear how much it reflected the children's museum experience or a temporary mood, raising questions about how children's museum experience can be investigated. An alternative to avoid this issue could be to arrange individual interviews, but it was feared that an individual interview with a newly met adult would have intimidated the children and that solitary tasks would have seemed pointless.

Finally, another limitation was found in the application of situated interviews to the study of guided tours, which are a form of live speech performance. Conducting a situated interview during an on-going tour would have disrupted the practice, making it impossible to gain any significant data. Therefore, a mixed methods approach was adopted, combining observations, interviews, and video recording. Hence, guided tours were closely observed and video recorded in order to capture how the guides and the children interacted with each other and to identify possible issues in the way guided tours were conducted. On later occasions, the guides were interviewed and filmed while re-enacting in the exhibition space what they do during a guided tour (see Table 2), in order to investigate how they related to their practice on a conscious level.

Despite limitations and collection of partial insights, a qualitative methodological triangulation can allow to capture glimpses of emergent issues, participants' needs, and values to be considered

[18] These observations and interviews were held in Winter 2010 and constitute the empirical basis of Paper 1 and 2.

Figure 6. Interview with the children at the afterschool facility.

in the design process. Triangulation prescribes to combine different methods, so that if these methods are adequately mixed, each of them can contribute with its strengths yet compensating for the weaknesses of the other selected methods (Casey and Murphy 2009).

For instance, interviews and observations are in an interesting relationship as the combination of the two can help find out about the conscious as well as the unconscious level of experience. On the other hand, the combination of different methods can allow the researcher to apply the methods that are more suitable to the different perspectives emerging from the study itself. In this study, the observations conducted on the museum space and on guided tours allowed me to analyse the meaning embodied in the exhibition and in the practice. Interviews were useful when discussing museum practitioners' aims and values and also their perception of the administrative and organisational level of practice (macro level-community plane), and how this affects everyday practice and choice of tools.

In conclusion, I aimed at a coherent methodological triangulation, combining methods that build on the same philosophical standpoints, such as: situated approaches to human activities, focus on individual experience, and mediated interaction, in order to contribute to the formulation of an inclusive/holistic framework, complementing the models proposed by Zimmerman et al. (2007) and Löwgren and Stolterman (2004).

4.2.3.2 Design Process

The design process is structured according to the user centred design cycle (Fig. 7-8) (Preece et al. 2011). This means that users, children and museum practitioners, were involved in the process from the beginning in an iterative process. Each of the iterations aimed at gaining insights and

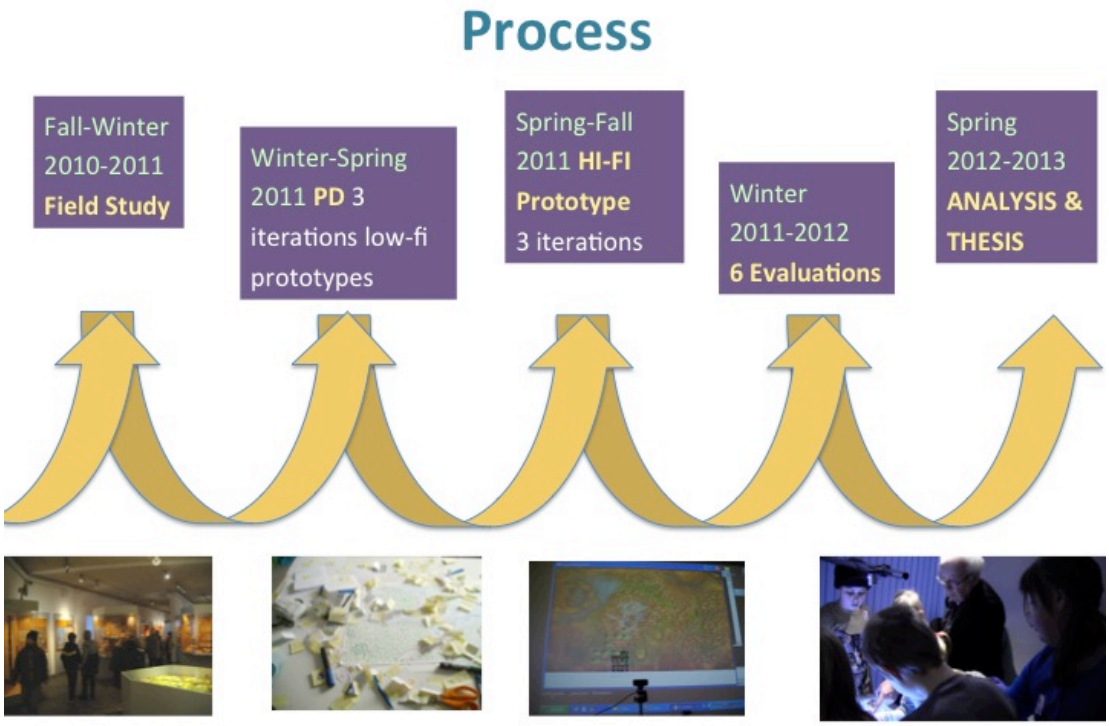

Figure 7.Overview of the design process (Paper 4).

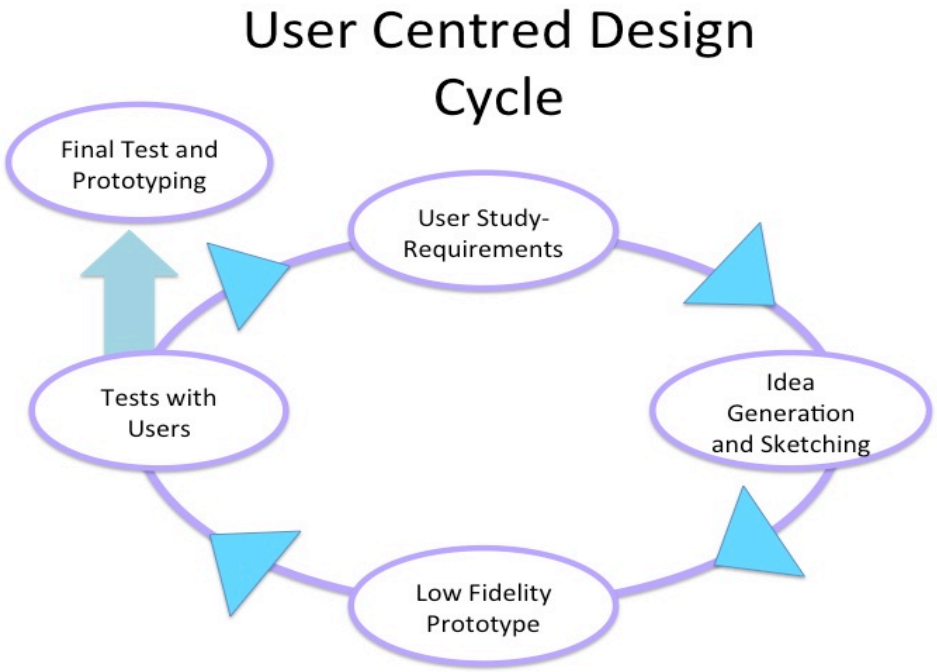

Figure 8. Interaction design cycle, after Preece et al. (2011).

Figure 9. Artefacts created by the children during the 1st and 2nd workshop: animals, Midgard Serpent, trees, a bridge and a defensive wall.

design requirements, based on which several low-fidelity prototypes were created and evaluated with users during the next iteration (Fig. 9, Table 2).

The main contexts of inquiry are the museum in Ribe and a local afterschool institution, from which a group of 25 children (10 years of age) was involved in the design of a tabletop game about the Viking Age. All together, the process includes four design iterations and about seven prototypes: four low-fidelity and three high-fidelity prototypes.

A total of four participatory design workshops were organised (Table 3) where the children participated in co-design activities in the afterschool facilities. During the first two workshops, the children were asked to construct prototypes for a tabletop game about the Viking Age engaging with various design materials, such as: coloured pencils, play dough, and Lego constructing bricks (as discussed in Paper 2 and in Marchetti 2011). These materials allowed the children to engage in a familiar situation of play and created prototypes, with no need for long introductory workshops, in line with Druin (1999). In this way, the children were left free to explore what they could do with the given material in order to avoid direct interferences from the researcher and confine their creativity (Fig. 9).

In the following two workshops, a low-fidelity prototype made of paper and cardboard was presented to the children with new designing materials, such as: post-its, markers, papers, and coloured pencils, suggesting them to focus on the proposed prototype. The children were also invited to play and to introduce changes and/or additions according to their needs. The participatory design workshops were held at the children's afterschool facility, a familiar space for the children to engage in different forms of play or creative activities while waiting for their parents. This facility represented an ideal design collaboratorium (Buur and Bødker 2002), a context for the workshops where prototypes and design materials could be stored and re-used for further reflections and discussion. A challenge emerged as not all the children could attend at the same time, so that most of the times a subgroup of the 25 children attended each session. A small group of three was present all the times while others missed some workshops.

The partial participation of the children might have created issues in relation to the reliability and validity of the data with respect to the intended target group (Preece et al. 2011), so that despite 25 children were officially involved in the design process, the gathered data might represent the perspective of a limited sub-group. The strategy I adopted to cope with this problem was to run the same kind of workshop twice, to give most children the opportunity to participate in the workshops. Specifically the first and the second workshop were conducted in the same format; the children were invited to freely design tangibles for the new exhibit with various design materials. Similarly the third and fourth workshops were also conducted in the same format and

the children were asked to play and modify a card-board prototype, adding new tangibles and rules of play.

Table 3. Overview of the workshops conducted during the design process and the evaluation of MicroCulture. The table specifies dates, the type of event, the context, the methods applied, and the focus of the analysis conducted on site and on the video material afterwards.

Date	Participants	Event	Location	Method	Focus
25/11/2010	Children from Oksbøl	1st participatory workshop	Afterschool	Cooperative prototyping with play-dough, Lego, drawing material. Observations and situated interviews	Children's perception and interest for the Viking Age and inspiration for design
24/01/2011	Children from Oksbøl	2nd participatory workshop	Afterschool		
08/04/2011	Children from Oksbøl	3rd participatory workshop	Afterschool	Cooperative prototyping with paper, post-its and drawing material. Observations and situated interviews	Evaluation and redesign of low-fi prototype
31/05/2011	Children from Oksbøl	4th participatory workshop	Afterschool		
19/12/2011	Curator from Ribe	Preliminary evaluation 1	University	Interview and observation while using the game	Usability and meaning of the game, plan for the evaluation with children
03/01/2012	Pedagogue from Oksbol	Preliminary evaluation 2			
05/01/2012	Guides from Ribe	Preliminary evaluation 3	Museum		
18/01/2012	8 children (9-10) from Oksbøl, who participated in the design process The two guides from Ribe	Evaluation 1	Guided tour at the Viking Museum in Ribe.	Ethnographic observations	Usability and meaning of the game for guided tours
18/01/2012	7 children (9-12) from Oksbøl, who did not participate in the design process The two guides from Ribe	Evaluation 2			
19/01/2012	8 children (9-12) from Bramming, who did not participate in the design process The two guides from Ribe	Evaluation 3			

During the workshops, ethnographic observations were conducted and a set of concise field notes were taken reporting notable forms of interaction or possible ideas emerging from looking at the children's prototypes. I did not participate in the co-design activities all the time not to interfere with the children's creative process, but I intervened when the children would ask questions or for help. Each session was video recorded and the collected video material was analysed through interaction analysis in combination with field notes in order to identify design requirements as further discussed in Paper 3 and in the Chapter 5.

From a theoretical perspective the design process and gathering of design requirements was aimed also at addressing the research sub-questions. For instance through the participatory workshops it should be possible to gain data about the sociocultural factors affecting how children experience museum learning practice, history, and how they would like to interact with a digital exhibit on urban development, in line with Apostolellis and Bowman (2015) and Lyons et al. (2015). Looking at the way the children shape their game and the interaction in which they engage, was expected give me a better understanding about the roles, social interaction, and the imaginary world they would like to enact during guided tours, hence new data to address the second sub-question. Through the making of prototypes I expect to see how they imagine the Viking Age, how much they know about it, which elements they find most interesting and which elements they would like to see in MicroCulture, in this way insights relevant to address the last sub-question should emerge. At the same time, these data could be analysed in terms of formulating expectations on the role digital technologies could play in learning of history during guided tours, hence indirectly contributing to the digitisation of museum learning practice (addressed in the main research question) from the perspective of the needs of the children.

4.2.3.3 Evaluations

In order to evaluate the high-fidelity prototype of MicroCulture, a set of six qualitative evaluations was conducted with the curator, the guides, the pedagogue, and the children (Table 3). In order to keep a coherent methodological framework for the study, the evaluations involved qualitative research methods similarly to the previous stages of the study: ethnographic observations, situated interviews, and interaction analysis on video recordings (Preece et al. 2011; Pink 2007; Jordan and Henderson 1995).

A set of three preliminary evaluations was conducted to evaluate the learning relevance of the prototype from the perspective of the curator and the guides from Ribe, and the pedagogue from the afterschool institution. The first two evaluations were run in the university and the last one in the museum. During the third evaluation, the guides were invited to plan the tour for the final evaluation, to discuss where to place the prototype within the museum, and how the guides should introduce MicroCulture to the children (a map showing the location of MicroCulture is visible in Fig. 10). These were critical aspects to determine how children and guides should interact with the prototype during the evaluation and how the tour itself would unfold. The suggestions gathered through the preliminary evaluations were integrated in the final, third high-fidelity prototype, which was tested with the children during three final evaluations.

The three final evaluations were conducted with the final prototype in mid-January 2011, involving three different groups of approximately seven children. It was expected that the children who collaborated to create MicroCulture might have developed a feeling of attachment to the prototype and that such feelings could have influenced their feedback. Therefore, it was decided to evaluate the prototype also with children who did not participate in the design process and belonging to a wider age group (9 to 12), in order to introduce a general perspective on the prototype and how it could affect children belonging to a wider age group.

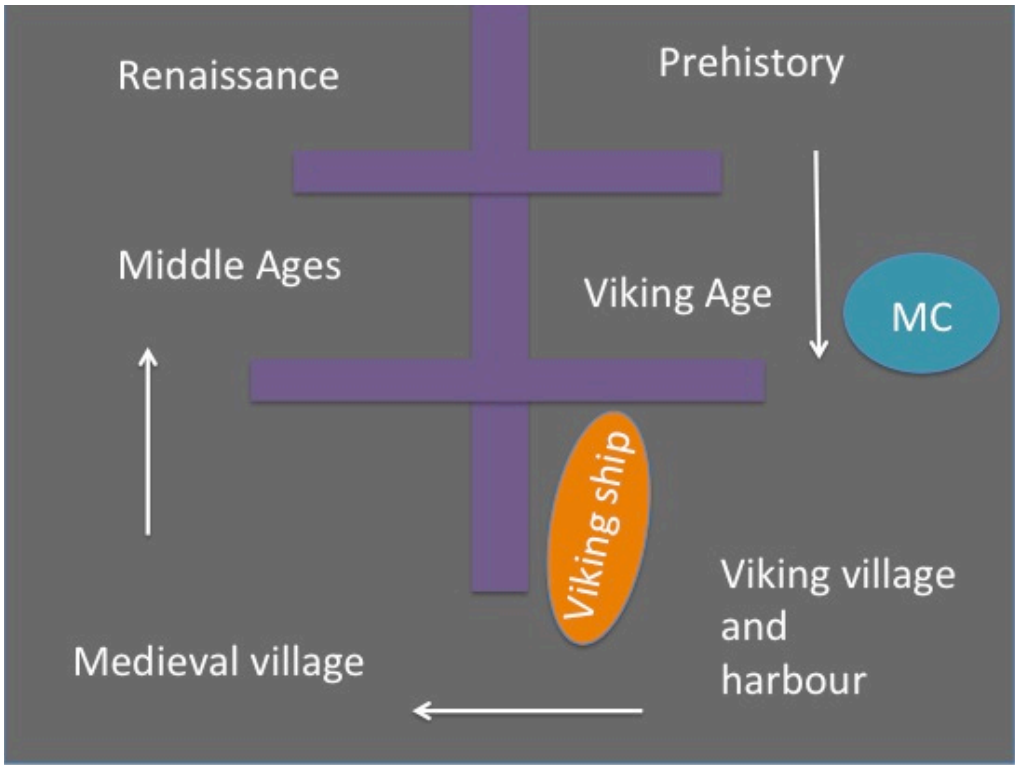

Figure 10. Setup for the final evaluation, MicroCulture (MC) is placed in the Viking Age exhibition area, the second room the children see during a guided tour.

The first group included the 8 children who participated in the design process. The children forming the second group came from the same afterschool facility, but did not participate in the design process, and the third group came from a similar afterschool facility. The three groups were invited to take a guided tour in the museum and evaluate a new game, so that the children and the guides could try the game as close as possible to a real guided tour situation. These evaluations were designed to be situated and participatory, integrating ethnographic methods within participatory design workshops. These methods were chosen because being originated within anthropological and ethnographic studies they are well suited to support analysis of details of social interaction and the meaning involved in human activities (Jordan and Henderson 1995). Moreover, these same methods were used through all my study to create a coherent methodological framework from the field study to the evaluation phase.

During the final evaluation, I tried to have minimal interaction with the participants in order to evaluate if they were able to engage with the prototype on their own. For this purpose, the guides were instructed on how to introduce the prototype to the children on their own.

Each guided tour lasted one hour, during which, the evaluation of MicroCulture took about 20-30 minutes. The prototype was placed in the middle of the Viking Age exhibition area, so that the children could have an introduction to the Viking Age before trying the exhibit (as visible in Fig. 10) but at the same time could be enabled to build up a playful state of mind early in their tour.

The evaluations were video-recorded and in the analysis, particular attention was dedicated to verbal language, actions, and facial expressions as cues related to individual needs regarding playful and learning experiences, as discussed in Paper 4. Based on the research questions (see chapter 1, section 1.2), the evaluations aimed at establishing:

- If and how MicroCulture fits within the identified sociocultural factors involved in museum learning practice;
- How a digital exhibit like MicroCulture could contribute to the shift in the role of museums, with respect to daily (micro level) and broader organisational practices (macro level)?
- How can digital technologies contribute to the practice of guided tours?
- How can such a digital exhibit enrich learning of history inside the museum?

The first two points address the main research question and the first sub-question, dealing respectively with how the design of digital exhibits could contribute to the on-going shift and with the sociocultural factors involved in museum learning practice. At the same time the analysis aimed at evaluating the quality of the design of MicroCulture from the perspective of the different needs of museum practitioners and children. As for the third and fourth point, the interaction between the children and the guides is analysed with respect to how they respond to the prototype and if the prototype fits their needs, hence indirectly addressing the second and third sub-questions dealing with guided tours and learning of history. Conclusions are drawn to reflect upon the results from a micro and macro level perspectives, with respect to: how social interaction and learning change through the introduction of mediated play, if mediated play enables the pupils to become active learners and if it fosters forms of learning and abstract thinking about history (Paper 1 and 2).

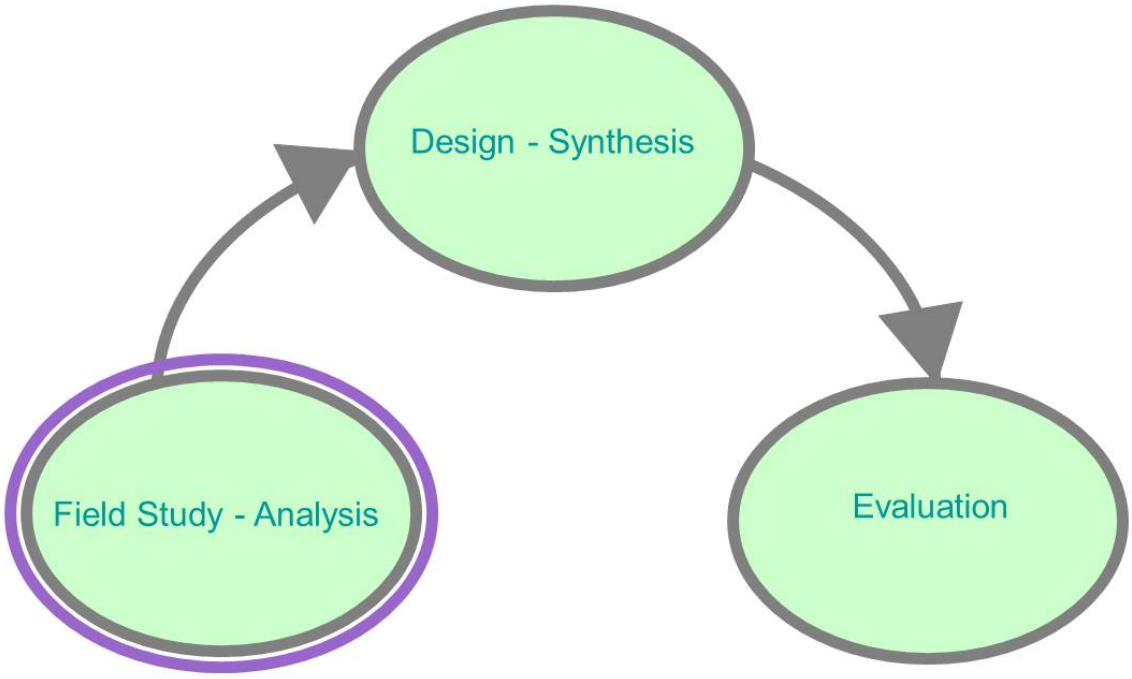

Figure 11. Three stages of the study.

5. Museum learning practice as a sociocultural activity. Reflections on the field study

As discussed in the previous chapter (4), the research discussed in this thesis is structured into three stages (Jones 1963[20]; Fig. 11): a field study, in which the problem domain is formulated and analysed, a design process aimed at synthesising findings from the field study into design requirements and prototypes, and evaluations during which the prototypes are tested in order to evaluate their qualities and formulate a knowledge contribution.

This chapter discusses findings gathered during the field study, which aimed at understanding museum learning practice as a sociocultural activity composed of different practices, among which are the guided tours. These are seen as a typical but little studied learning practice, wherein museum practitioners and visitors literally meet each other. The field study attempts, therefore, to reconstruct the understanding of guided tours combining the perspectives of museum practitioners and primary school pupils. Gathered data are analysed in order to define requirements for the design process and address the research questions in relation to the included papers.

The next section discusses the gathered data and requirements in relation to the on-going shift in the role of museums (5.1), the second section focuses on the sociocultural factors involved in

[20] See chapter 4, section 4.2.3.

museum learning practice and more specifically in guided tours (5.2). The third section outlines the data and the requirements that emerged during the field study for the design of a digital exhibit aimed at supporting learning of history (5.3).

5.1 Museum learning practice, tangible exhibits, and the shift

Interviews with the museum practitioners revealed that the on-going shift is affecting the introduction of new technologies in museums. This discussion is mainly based on Paper 1, which reflects on the impact of the shift of museum learning practice and its digitisation. The paper builds on the notions of global network (Law and Callon 1995) and of double bind (Bateson 1972), in order to analyse how external pressures are affecting the on-going shift and more specifically the digitisation of museum learning practice. A global network is defined by Law and Callon as "a set of relations between an actor and its neighbours and the neighbours and others" (Law and Callon 1992, p. 21; Paper 1 p. 3). According to the two authors, a favourable global network is needed to support innovation, providing a "negotiation space," which includes resources and a span of time for the innovation process, as discussed in Paper 1.

When referring to the shift, the museum practitioners did not use a specific term, but talked more generally about an "innovation process" or simply a "process" that is going on. On a general level, the curators from both museums perceive their freedom to take charge of their shift constrained by "external influences" from other institutions, as discussed in literature (Reeve and Woollard 2006, p. 5). In Paper 1, I see these external institutions as constituting the museum's global network, as defined by Law and Callon (1992). Funding organisations are acknowledged as main actors, demanding from museums to prove their relevance and to become "more entrepreneurial"[21] in managing their resources, so to attract more visitors despite financial cuts (Reeve and Woollard 2006; Fleming 2005; Crowley and Jacobs 2002). Furthermore, curators feel pressure from the demands of the educational system, especially in UK, where the head educator from Coventry pointed out that local teachers demand for "a pure chronological narrative," which "is easy" to discuss in class and "fits well with the objectives of their teaching programme" (Paper 1 p. 16). This aspect is confirmed by museum studies, arguing that the British educational system is restrictive in setting criteria for museums regarding arts and history related subjects (Reeve 2006, p. 50).

Therefore, museum practitioners perceive that their practice and opportunities for innovation are threatened by external institutions trapping museums within a "double bind," a paradoxical situation in which every possible choice leads to failure[22] (Bateson 1972, p. 156; Paper 1, p. 16). In the specific case of museums, the double bind is found in the double requirement for museums to innovate their practice while managing better their resources, even with decreasing budgets. At the same time, museum practitioners are receiving specific instructions on how to carry their learning practice through the educational system of their countries. As a result, curators from both museums are not sure how to innovate their practice and have not changed their main exhibitions, despite having defined these exhibitions as "old" or "old fashion." Both curators expressed their desire to try something new and different, but as the curator from Ribe said, "it is not clear how to improve it (the exhibition)." The curator from Coventry echoed: "we

---

21 Quote from the curator of the Transport Museum, interview dated to 15th December 2010; the results from this interview are discussed in Paper 1, p. 16. The same terms are used in literature (Fleming 2005, Reeve and Woollard 2006).

22 Bateson introduces this notion to analyse the origin and causes of schizophrenia in individuals (Bateson 1972).

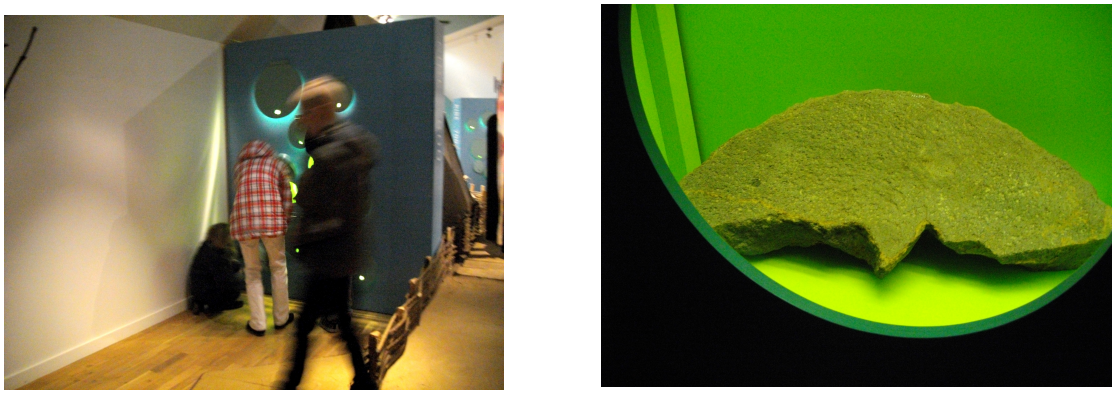

Figure 12. "Why Ribe?" on the left: cabinets and building installation (Paper 5); on the right: cabinet with a milling stone (Paper 1).

don't know why people like it, or not, and we have pressure on our shoulders, we cannot take risks."

Despite this unsettled situation, both museums are actively pursuing innovation and have created for themselves a safe space for innovation through the emergent practice of "innovation enclosures," as I call it in Paper 1 (p. 18). This practice involves the creation of new minor activities, such as temporary and/or thematic exhibitions. Concrete examples are the already mentioned exhibitions "Why Ribe?" that opened in Ribe in August 2010, and "Ghost Town" in Coventry, which have been running for a few years.

The exhibition called "Why Ribe?" (Fig. 12) was aimed at communicating to visitors the tentative nature of historical practice. This setting is targeted at families and younger visitors. It includes a series of tangible exhibits made with non-digital materials, such as a building installation for children to try out medieval cranes playing with plastic bricks and cabinets displaying fragmented artefacts to reproduce the experience of archaeological excavations.

The thematic exhibition entitled "Ghost Town - What happened to Coventry car industry?" (Fig. 13) has also a different approach in comparison to traditional diachronic exhibitions. It was created by a group of design students from Coventry University and it focuses on the financial crisis, which affected local cars manufacturers in the 80's. This crisis is still a sensitive matter because it caused a higher unemployment rate and also a feeling of "identity loss[23]," in relation to Coventry tradition in the manufacturing of vehicles, which is dated back to the Victorian age. This exhibition is located in a secondary wing of the museum and shows the luxury vehicles produced by the now closed factories. According to the curator, the exhibition was successful because it elicited strong feelings and an animated "dialogue" with the visitors. As discussed in Paper 1, the curator reported that some visitors commented positively on the display, saying that the exhibition "moved them and recalled personal memories." Others instead criticised it for being "inappropriate and inconsiderate" towards the people who lost their jobs.

The emergence of innovation enclosure is rich in implications regarding the sociocultural values involved in the shift of museum learning practice. For instance, it shows that practitioners are motivated in exploring different forms of interaction. However, if a thematic exhibit is successful, it is kept running beside the main exhibition, where no changes are produced. thematic exhibit is successful, it is kept running beside the main exhibition, where no changes are produced. This seems to indicate that despite that museums were able to define a safe space for creative

[23] As according to the curator of the museum, December 2010, Paper 1, p. 21.

Figure 13. "Ghost Town" exhibition in Coventry (Paper 1).

explorations; these explorations do not contribute to the shift, as changes are not made on the main exhibition. This also suggests that museums identify themselves with their main exhibition, therefore, they are not willing to take risks in endangering its quality as this might endanger the museums' reputation: a valuable commodity to attract financial support, an issue discussed by Janes (2009) and Reeve and Woollard (2006).

At the same time, curators are not technology experts and are sceptical about the pedagogical value of digital technologies (Janes 2009). According to the curator from Ribe, it is easy to see the motivational contribution of digital technologies, but there is a risk that they might "attract attention to irrelevant matters," and that "children may play with the interface without learning much." Moreover, digital technologies are perceived as expensive and confusing, as there are many different kinds of technologies on the market and it is not clear which one to choose. In this respect, the digitisation of museum learning practice is perceived as the demand of turning museums into entrepreneurial practices as it was not decided by museum practitioners and, as articulated by the curator from Coventry, it requires "a set of skills that we (curators) do not have!" The head museologist from Ribe also argues: "I am in a learning process, I am becoming wiser in what technologies can do for me[24]." This could mean that in order to support the digitisation of museum learning practice, a new set of skills should be gained by museums, either by hiring or cooperating with professionals from the IT world, or through requalification programmes for museum practitioners (Woollard 2006).

Furthermore, the museologist from Ribe is critical about the current state of museum studies and its fragmentation. She argues that: "museum studies focus on the philosophical level of curatorial work," which she says "it feels strange and I cannot use for my daily work." She in fact claims that studies about curatorial work provide "uneasy" depictions of her daily practice, but do not suggest how to improve it. On the other hand, even if interaction design studies could offer interesting solutions, she claims that she needs to know more explicitly: "what's in it for me?" arguing that "technologies should solve my problems, which come from what I have experienced in relation to the visitors." In this respect, she has precise requirements, such as: technologies should support learning and should be cheap as museum financial resources are limited. Technologies should also be stable and easy to operate by non-experts (a classical maintenance requirement when IT is concerned), moreover, it has to "disappear as much as possible when it doesn't work," because "it is very annoying for the visitors to see the *out of order* sign." At the end of the interview she said that found "pleasant" that my study was so focused on discussing museum practitioners' needs with regard to the digitisation of museum learning practice.

[24] Interview conducted on the 25th of April 2014.

In conclusion, the requirements expressed by the museologist provided me with concrete foci for my design requirements, at the same time shedding light on museum practitioners' scepticism on technologies and confirming the need for a framework for interaction design research targeted at museums, taking into account the needs emerging from the museum practitioners in relation to their practice and the on-going shift.

5.1.1 Design Requirements

It is argued in this thesis that the design of digital technologies targeted at museums should contribute to the on-going shift, facilitating a stable integration of digital technologies within museum learning practice, wherein digital technologies are not perceived by museum practitioners as a new, doubtful trend. Data gathered through the field study suggest that the digitation of museum learning practice is problematic because it was imposed through external influences, it demands for skills that museum practitioners do not own, and it is not clear which benefits will bring. In this respect, it becomes vital to contextualise the role of digital technologies within existing practices, such as guided tours and innovation enclosures. The practical requirements listed by the museologist from Ribe provide concrete foci for the design process and outcome, which should be:

1. Supporting her practice in relation to learning;
2. Easy to operate by non-experts;
3. Cheap and easy to maintain or hide.

Consideration of these practical issues, such as costs, administration, and maintenance, has methodological implications as it represents an extension of the holistic model proposed by Zimmerman et al. (2007)[25]. As discussed in chapter 4, Zimmerman et al. dismiss the need for design researchers to include economy and administration in their inquiry. The dismissal of economic and administrative matters might be relevant for studies focusing on the individual dimension of visitors' experience, with the risk of not supporting the needs of one large group of users, in relation to their experience and the organisational level of their practice. However, when investigating the role of technologies within museums as learning institutions, the organisational level of museum learning practice becomes important as it directly affects acquisition of new tools and materials.

This discussion is further developed in Paper 5, which expands the discussion presented in Paper 1, complementing it with new reflections gained through the design process. In Paper 5, it is in fact argued that a stable integration of digital off-the-shelf technologies can be achieved contextualising digital exhibits within the practice of innovation enclosures, supporting museum practitioners' explorations of new digital exhibits and in connecting with existing communities of software developers, without having to depend on expensive custom solutions. In this way, digital exhibits are seen as potential boundary objects (Star and Griesemer 1989), creating space for negotiation of meaning between museums and their community of visitors and IT experts.

[25] See chapter 4, section 4.1.

5.2 Guided tour as a sociocultural activity

The field study discussed in this thesis has the aim of defining the nature of guided tours from the perspective of the key participants: museum practitioners (in particular guides) and primary school children. The field study was conducted in Coventry and in Ribe and its results are expected to contribute to the knowledge of guided tour practice: more specifically about how the participants perceive it and participate in it.

In the initial stage of the field study, it was necessary to establish contact with the practitioners from the two museums; hence, I started investigating their perspectives on guided tours and museum learning practice in general. In the paper Marchetti (2011a), which was published at the Participatory Innovation Conference (PINC) in 2011, I reflected upon the evidences gathered through interviews with museum practitioners in both museums and observations of a guided tour in Ribe. In Marchetti (2011b), I reflected about how the children relate to the practice of guided tours and to the museum environment. Empirical data were gathered through interviews and observations of guided and free tours in Ribe and Coventry. The perspective emerging from these papers enabled me to analyse how guided tours are perceived by the participants and their needs in relation to the practice. Paper 1 was included in this thesis because it combines reflections on the practice of guided tours with reflections on the on-going shift, while Marchetti 2011a and Marchetti 2011b discuss guided tours from a more limited perspective.

In the next sections, findings from the empirical study are discussed in relation to how guided tours are seen respectively by guides and children (sections 5.2.1 and 5.2.2), and in section 5.2.3, the established requirements for design are presented.

5.2.1 Guided tours seen by the museum practitioners

The interviews conducted during the study revealed that both museums are active in organising new activities and thematic exhibitions for their young visitors, where their main goal is to support children in learning more about history. On a general level, both curators used the word "mono-directional" to define the communication taking place between museums and the visitors, as discussed in Paper 4. The mono-directional nature of museum communication is seen by both curators as an issue, in relation to how museum practitioners can reach the visitors and find out about what are their interests and what do they gain from a museum visit. In this respect, both museums consider the guided tour a "useful and central activity" (quote from the curator from Ribe) to support young visitors in grasping the historical meaning of the exhibition. According to practitioners from both museums, an exhibition is not self-explanatory in itself; this means that only visitors who are knowledgeable in history can make sense of an exhibition just looking at it.

Moreover, during the interview, the head of education from Coventry pointed out that "school teachers see a value in guided tours" with respect to learning of history. According to practitioners from both museums, guided tours help teachers to contextualise the content of their lectures, enabling the children to see authentic artefacts and to reconnect what they heard in class with what they saw and heard inside the museum. Moreover, as some practitioners from Coventry pointed out, guided tours represent in many cases the first experience of museums for children, hence it emerged as a common goal to both museums to provide children with a "nice experience" under the form of "a good story," that could be "memorable, fun, and educational" (Marchetti 2011a, p. 101; Paper 2, p. 97). A good story should "elicit a certain curiosity in the children, so that they may become inquisitive about the story of their family and so of their own identity" as discussed in Paper 2 and Marchetti (2011a, p. 101). Generalising from the gathered

data with respect to literature review, it emerges that museum practitioners act from the inside of the museum on a personal/interpersonal plane (micro level), to fulfil the museum's ambitions on the community plane (macro level), such as eliciting in the children who visit the museum an interest for their cultural heritage. This perspective of the practitioners from Ribe and Coventry is in line with current museum studies, which argue that museums should engage in a dialogue with young visitors to contribute to the formation of active citizens (Dysthe et al. 2012; Hooper-Greenhill et al. 2004).

Through their experience, guides and educators from both museums have elaborated similar strategies, in relation to how to tell a good story to the children, such as (Paper 2, p. 97):

- Selection of objects according to the age of the visitors;
- Asking questions to turn children into active learners;
- Looking at children's gazes to identify which objects are interesting for them.

The two guides from Ribe, a man and a woman around 60 years old, agreed that in order to tell a good story, it is important to present a selection of artefacts, to which children could relate. For instance, the male guide, a retired school teacher, says that maps and coins "are not interesting for the kids" and that he prefers to tell them stories about everyday life artefacts such as: clothes, weapons, and reconstructions of settlements. The female guide, who is a retired businesswoman with a passion for history says instead that coins and maps are interesting artefacts as they allow discussing "comparisons between the past and the present." For example, showing the coins that were made in Ribe she would tell to the children: "it is like when you go to Germany or England and you have to exchange your money, in the same way merchants had to exchange their coins before being able to do their business in Ribe."

Two artefacts from the Viking Age were particularly popular according to both guides: a smooth bone used as a skating blade and a cow dropping, which has been transmuted through time into something similar to a grey round rock (Marchetti 2011a). Furthermore, to avoid that the children might "fall asleep" during the tour, the guides try to keep the children active by asking them to recognise specific artefacts that could be interesting for them. For example, during the guided tour I observed, the guide showed the skating bone to the children and asked: "what do you think it is?" Since none was able to answer, he provided a cue by singing a song and placing the bone under his foot, afterwards all the children understood that it was a skating blade and many raised their hands (Marchetti 2011a). Another way to attract the interest of the children is to ask the children to find a specific artefact among other fragments displayed in the same cabinet, such as: a sword, a piece of jewellery, or another object. Finally, it emerged from the study that the guides are aware that each group and each individual visitor has different needs, and in order to find out which artefacts a child might be interested in, the guides have learnt to "look at what that child is looking at," in order to find out how to tell a story that could be interesting for the children as individuals (Marchetti 2011a).

Interestingly, guided tours are performed in Ribe by retired individuals, who have different backgrounds but have gone through the same training course; guided tours in Coventry are instead performed by professional "educators," often women of different ages, who have an academic education in the humanities. In the UK, the professional training of museum educators and their professional role is being questioned as part of the on-going shift (Woollard 2006). During my participation in a conference, I have been asked if the old age and the mixed background of the Danish guides could have affected the guided tour practice negatively. In fact,

no evidence was found in the video material that pointed at significant differences in the way the children and the guides approached each other socially in the two museums.

As discussed in Marchetti (2011a, 2012), the guides perceive themselves as storytellers and they attempt to enrich their storytelling activity by adding an aspect of riddle games in order to invite the children to participate in telling the story of the artefacts displayed. According to Huizinga (1950), riddle games are among the oldest forms of games, reported in poetry and myth. Already in Ancient Greece, these kinds of games were vital elements in social interaction, as they can fit within different forms of literary and rhythmical discourse. Riddle games emerged as a form of sacred play, in the form of knowledge competitions during rituals; hence, these games were positioned by Huizinga in between seriousness and playfulness. However, this dual nature was lost through time, branching into mysticism and philosophy or pure recreation (Huizinga 1950).

The practice of guided tours observed in the two museums makes instrumental use of the serious and playful nature of riddle games, to capture the attention of the children during the tour and foster learning of history. Based on these premises, it is argued in Marchetti (2011a) that during guided tours, riddle games regain their duality of playfulness and seriousness, as they are used to elicit learning and engagement at the same time.

The emergence of these strategies confirms Best's claim (2012) that the guided tour is an interactive practice, in which guides make an active effort to actively involve their audience in a dialogue.

5.2.2 Guided tours seen by the children

Despite the commitment of the guides in engaging in a dialogue with the children, museum learning practice and guided tours are defined both in Ribe and Coventry as a "mono-directional communication[26]" addressed to individual visitors (micro level) and society as a whole (macro level), as discussed in Paper 1 and 5. The curator from Ribe pointed out that "communication" might not be the right term to define museum learning practice, "dissemination[27]" could instead be more appropriate, as it is the museum who tells stories and make announcements to the public and not the opposite. Based on these premises, Paper 2 (included in the thesis) and Marchetti 2011b discuss how children and guides interact with each other during guided tours. Starting from insights gathered during the field study and from reflections on Rogoff's (1990) theories, Paper 2 proposes a scenario in which the introduction of playful digital exhibits enables guides and children to participate in guided tours on a more equal basis, more details will be provided in chapter 6, discussing the design process.
When investigating the children's perspective on their museum experience, results from the field study suggest that children are mostly interested in living beings and their stories (Marchetti 2011b), and that guided tours are actually challenged by the emergence of a mono-directional communication.

During the first interview with the children, which were conducted at the after school centre in Oksbøl, the children commented positively about their museum experience saying that museums are "nice," "fun," and even "educational" (Marchetti 2001b). However, further questions revealed that the children were not referring to historical museums, but to *The Fisheries and*

---

[26] Quote from the curator from Ribe and the head educator from Coventry, Paper 4, p. 134.

[27] The curator from Ribe used the Danish term "formidling", which according to him could be translated into "dissemination", meaning that museums spread knowledge to the public without really engaging in communication.

Figure 14. Statue of a man dying of plague and two girls from Oksbøl watching two medieval skeletons, Ribe (Marchetti 2011b).

Maritime Museum in Esbjerg, which is not the most typical museum. This answer was unexpected, as when using the word museum with the children, I meant historical or art museums, while this particular museum is instead a local aquarium displaying living fish and sea mammals. Continuing my dialogue with the children, it emerged that they have visited local historical and art museums with their school. However, when the children were asked about the last museum experience they remember, historical museums did not come to their mind. During a picture sorting exercise (Scaife and Rogers 1999) with images showing artefacts from the museum in Ribe, all the children showed interest for a sculpture reproducing a man dying of plague (Fig. 14). Moreover, as discussed in Marchetti 2011b, during a visit to the museum the same children showed interest for two medieval skeletons and asked questions about who they were and how they died (Fig. 14). These occurrences suggest that children experience a stronger emotional response, when confronted with living beings, animals, or people even if they were dead a long time ago, than with ancient artefacts, like pottery or weapons.
These results seem to contradict the guides' statement that the children are most interested in artefacts that have references to their everyday life, like the Viking Age skating blade. But in fact these results help to complement and contextualise the guides' perspective, clarifying that the children are interested in the life of human beings. This means that the children are not interested in ancient everyday objects per se, but because these objects tell stories about the life of their owners, in this respect, human remains are even more intriguing than their artefacts.

This perspective helps understanding also other recollections from the same guides, according to whom when a group of girls heard that in the Middle Ages girls got married at 12, they seemed puzzled and shocked. The guide said: "they (the girls) were talking as if they imagined themselves getting married to one of their classmates." Similarly, the boys were shocked when they were told that in the Middle Ages, only boys went to school and were beaten by their teacher (Marchetti 2011b), as if they imagined themselves being beaten in school. These insights suggest that children tend to identify themselves with stories of people from the past and were used as basis for the design process. In Marchetti (2011b), I discuss these insights further, reflecting upon how the children are affected by museum experience and in particular by guided tours. The children were emotionally affected by the skeletons and the stories of individuals from the past and became interested in knowing more about them. The children's response is in line with the studies conducted by Dindler et al. (2010). According to whom, young visitors are more interested in museum exhibits if these represent knowledge that has connections to their own life experience. This behaviour could be explained as an instance of Vygotsky's theory (1978),

according to which when children interact with physical toys are projected into a fantasy world, speculating on which actions they could perform and which consequences might derive.

According to Vygostky, this contemplation leads towards the development of conceptual thinking and learning through forms of role-play and problem solving. Mapping this theory into museum experience, it is possible to argue that when children encounter ancient artefacts and their stories, they engage in conceptual thinking imagining themselves as characters of such stories. As a result, conceptual thinking unfolds through identification and role-play dynamics, allowing children to imagine the possible lives they could have experienced if they were born at a different time. Learning through guided tours is, therefore, not a mere acquisition of knowledge, but a process of emotional and imaginative appropriation of the display and its meaning (Rogoff 1990, 1995). This aspect will be discussed further in chapter 6, section 6.3 and 6.4 in order to investigate how to enhance guided tours through the design of a digital exhibit.

During the interviews, the children claimed that their museum experience is negatively affected by limited possibilities of "something to do." Data gathered through the interviews suggest that museums can be boring because "you cannot touch anything and you cannot run!" hence, "you could not do anything!" as discussed in Paper 2. This issue seems to point at a need of empowerment in relation to the mono-directional communication emerging during guided tours and the limited possibilities of young visitors to decide on their own actions during guided tours.

According to the literature discussed in chapter 2, museum visitors can be empowered either through free choice of actions (Hornecker 2008) or by being allowed to share individual interpretations on the exhibition regardless of official theories (Pierroux 2010). I have instead found in this study that during guided tours the children are supposed to follow the guides, who are in control of the activity, as pointed out in Dindler and Iversen (2009). In this respect, children's freedom of action is constrained. Moreover, it was observed that in both museums, the children do not talk freely or directly to the guides, which means that the children do not make active use of social guidance and their opportunity of gaining control on their museum experience is restricted. In this sense museum learning practice emerges as mono-directional and limits the possibility for children to formulate and share their individual interpretations of historical knowledge. As a consequence, it becomes a challenge for the guides to find out about the children's individual interpretations of the exhibition and have a discussion about these.

The same issue is identified from the community/macro level, so that the curator from Coventry claims that it is a challenge to make sense of the visitors' wishes, what they like or not, and if they learned something through their visit. In fact, the curators from both museums have attempted to engage in a dialogue with their audience, for instance, introducing stands to collect feedback about their thematic exhibitions. In Coventry, the visitors could leave their comments on a message board and in Ribe, they could signal what should be improved by throwing a ball into three transparent pipes (Fig. 15). Finally, the museologist from Ribe claims that she gets a lot of useful information from the desk staff selling tickets to the visitors. However, that information was said to be partial and sometimes not so easy to gain in a structured and comprehensive way, as it emerges mostly through casual talks. In conclusion, engaging in communication with the visitors is regarded as a difficult task, for which the Transport Museum in Coventry has also tried to hire marketing professionals, but without substantial results with respect to how the exhibition could be improved.

5.2.3 Design Requirements

Figure 15. Stands for feedback at the two museums, on the left Ribe and on the right Coventry (Marchetti 2011a).

All the insights gathered through the field study enabled me to formulate design requirements for the creation of MicroCulture, such as: to represent the stories of living beings (humans and animals) in order to support the children in gaining knowledge that interests them and also to empower the children in their interaction with the guides.

Guided tours were found to be, in principle, an interactive practice as according to Best (2012). However, this practice is disrupted by the emerging mono-directional communication and by the limited opportunities for children to make active use of guidance in their learning process. Hence, the main requirement emerging from the field study conducted in the two museums is that a digital exhibit should support the empowerment of children in their learning by eliciting a dialogue between children and guides.

According to Rogoff (1990), any interpersonal interaction is seen as a dialogue, where partners equally share their participation. But in reality, partners agree on a variety of arrangements compensating for existing asymmetries. This is even more valid in the case of learning situations, in which there is a clear asymmetry between facilitators and learners. This asymmetry is due to the different level of skills of the participants and their roles in guiding and learning (Rogoff 1990). However, it might happen that even the more skilled facilitators gain new knowledge on the practice at hand through their facilitation role and mutual engagement with learners (Rogoff 1990).

Similar asymmetries were identified also during guided tours, which were found to converge more towards a lecture than a dialogue involving mutual engagement, where the guides act as facilitators and appear more active than their learners. Building on Rogoff (1990), the goal of the study discussed in this thesis is to make guided tours converge more towards a dialogue, defined as a mutual, interactive pursuit, as according to Rogoff (1990) and Best (2012). In this respect, it

is argued that the design of digital exhibits could focus on eliciting a dialogue between the children and the guides, enabling them to negotiate possible actions and sharing of meaning.

At the same time, the requirement of empowerment emerged also from the museum practitioners participating in this study. Both curators from Ribe and Coventry claimed that the shift in the role of museums is not under their control, as it is influenced by external institutions deciding on the future of museums. The on-going digitisation of museum learning practice is contributing to this loss of control, demanding for skills and values that do not belong to museum practitioners.

In this respect, both children and practitioners share an issue of loss of control, with respect to how museum learning practice is taking place and on how it is being redefined through the shift. Digital exhibits are seen in this study as a tool to empower both groups of users. In the case of children, the design of new digital exhibits can create opportunities for individualised forms of playful interaction, as argued in Hornecker and Stifter (2006), leveraging on their personal interests (Dindler and Iversen 2009) and alleviating the interactional limitations associated with guided tours. Ideally, digital exhibits should acquire the duality of seriousness and playfulness, identified in riddle games, enabling children to engage in a playful but instructional dialogue with the guides. This dialogue is expected to facilitate children to reflect on the meaning of the exhibition, to express their impressions to the guides, and to negotiate with the guides on their course of actions. Furthermore, if digital exhibits are successful in meeting these requirements, museum practitioners will be able to gather useful information to adjust to the visitors' needs during guided tour practice from a micro level perspective, and also to gain meaningful knowledge about visitors' experience, which could help in adjusting other learning practices from a macro level perspective.

5.3 Digital exhibits and learning of history

Current literature suggests that digital exhibits can support visitors in expressing their individuality (Lischke et al. 2014; Ciolfi 2012; Hornecker 2008; Hornecker and Stifter 2006), support visitors' activities (Lyons et al. 2015; Muratsu et al. 2014), bridge visitors' everyday life to their museum experience (Iversen and Smith 2012; Dindler and Iversen 2009), and provide a playful framework to museum experience (Apostolellis and Bowman 2015; Lyons et al. 2015; Muise and Wakkary 2010).

It was observed that the museums involved in this study make use of tangible exhibits, which can support playful interactions and engagement, but which are not digital. Therefore, questions emerge in relation to how digital exhibits contribute to learning of history[28], a central aspect of museum learning practice and of this thesis.

In the following sections, empirical data are discussed in relation to how museum practitioners (5.3.1) and children (5.3.2) relate to history and museum tangible exhibits. Finally, section 5.3.3 discusses the gained design requirements.

5.3.1 Museum practitioners and learning of history

[28] This perspective is introduced in chapter 3, section 3.4.

Figure 16. Screens showing a blacksmith forge, Ribe (left) (Paper 5) and old news about the 80's financial crisis, (right) (Paper 1 and 5), Coventry.

Figure 17. Viking ship during a guided tour in Ribe (Marchetti 2011a).

Data from the field study suggest that the goal of the two museums is to support school children in learning history through two main categories of exhibits, which I call in Paper 1 "sacred" and "mundane" objects. This categorisation results from the different expectations in fruition of museum ancient artefacts and contemporary reconstructions. Antiquities are regarded as sacred objects and are segregated from the visitors physically as well as cognitively. These are, in many cases, small fragments of partially destroyed objects and practitioners expect that visitors will not touch these objects not to endanger their preservation. The existence of museums is still motivated by the preservation and display of ancient artefacts or biological specimens eventually found in ancient trash wells. These objects have often been altered by a long permanence under the ground where exposure to humidity, acidity of the soil, alteration in temperature and weather conditions, or agricultural works performed on the surface might have produced significant changes in their shape and materials. Therefore, as if they were sacred objects, ancient artefacts are displayed in glass cabinets to secure their preservation, in this sense they are physically segregated from the visitors, who can only see them. But ancient artefacts are also cognitively segregated from the visitors, as a significant amount of historical knowledge is required for the visitors to be able to identify them. Moreover, the mentioned physical alterations can make ancient artefacts unrecognisable also to an expert's eye.

In order to orient the visitors, the two museums provide tangible exhibits like reconstructions or explicative signs. These are not authentic artefacts and do not share the same sacred aura of ancient artefacts, hence, they belong to the category of mundane objects (Paper 1), which in some cases can be made available for the visitors to touch and play. During the time the study was conducted, none of the two museums displayed digital exhibits, but displayed many tangible exhibits, offering a certain degree of interactivity with cabinets to open and passive screens (Fig. 16) showing either old practices or clips from old news (for more details see next section 5.3 and Paper 1).

Observations during guided tours conducted in the two museums revealed that tangible exhibits play a key role in supporting learning of history and storytelling practice. First of all these exhibits offer a contextualisation of ancient artefacts, showing how different artefacts looked in their integrity, completing the information missing in the original artefact. Second, as already mentioned in section 5.2.1 of this chapter, guides and educators make instrumental use of exhibits as starting point for their stories. For instance, during a guided tour in Ribe, the guide asked the children to sit on the reconstruction of a Viking ship (Fig. 17) and afterwards he evoked lively images of how it could have felt like to participate in a raid. The guide told the children to "imagine how hard it was to sail from Denmark to England," he added that "it took about 10 days" and that "the Vikings had to survive in stormy weather conditions, with no roof, little fresh water to share, and no toilet" (Marchetti 2011a). During observations, these stories seemed to capture the attention of the children, who looked at the guides while sitting still on the Viking ship.

The mentioned episode from Ribe and data from interviews suggest that tangible exhibits are used in the two museums to support a synchronic and authentic approach to learning of history. Tangible exhibits, such as the above mentioned Viking ship, are introduced to create an illusion of immersion, shortening the distance between the visitors and the past, as discussed in Paper 5. This approach is interpreted by the curator from Ribe as an application of the principle of "authenticity," a central principle for the creation of new exhibits and for learning. According to the curator from Ribe, the adoption of the principle of authenticity requires that museum exhibitions should display faithful reconstructions of ancient objects. The adoption of this approach leveraging on authenticity is expected to support museum learning practice from a macro level perspective, contributing to the education of young citizens, who are aware of their cultural heritage, technological progress, and of the differences between their life style and that of their ancestors.

On the other hand, while conforming to the principle of authenticity, the tangible exhibits displayed in the two museums tend to represent the past as a sequence of facts, happening at a precise point in time. However, history is a social process, unfolding through time and involving individuals as social beings (Carr 2001). When it comes to tell stories about history as a social process, the dominant form of communication is represented by verbal narratives, such as: the guides' lecturing, written signs, publications, or cultural events. None of the two museums displayed tangible exhibits showing for instance social or geological changes in a tangible form. The only tangible representation of history as a process is the exhibition layout, in which archaeological artefacts are displayed starting from the most ancient to end with the most recent. This typical layout attempts to concretise the flow of time into space resulting into a walk through the past, as discussed in Paper 1. In this thesis and in Paper 2, it is argued that verbal narratives and their sequential character might depict history as a sequence of names and facts, hindering the emergence of a critical understanding of history as a process flowing through time.

As discussed in Paper 1, alternative layouts were not explored because of the influence of school teachers who, according to the curator from Coventry, "want simple sequences of facts, which are easy to discuss with the children in class." Moreover, as I asked both curators if they have considered representing historical processes through tangible exhibits, it emerged that both museums have thought of it, but this task was perceived as "too abstract" and "too difficult." Therefore, the idea was not given a try, but as I proposed to explore it in my study the curator from Ribe said: "it would be nice if some solutions could be found![30]"

A more critical approach to learning of history is represented by the concept behind the thematic exhibition *Why Ribe?* (Marchetti 2011 a). According to the curator and to the head museologist of the Viking Museum in Ribe, the main exhibition displayed in their museum is based on an assumption that museum practitioners know "the truth!" Both practitioners say that this is not true and that this assumption is eliciting "a wrong understanding of what history actually is." Therefore, in recent years, it became the mission of the museum to enable the public to discover "the tentative nature of historical practice, which is characterised by uncertainty.[31]" Hence the exhibition *Why Ribe?* was created to tell visitors, young and old, that historians and archaeologists do not know the truth, but that they formulate hypotheses by analysing the available materials and textual sources. Therefore, the exhibition includes a series of tangible low-tech exhibits to simulate the practices of excavation, identification, and reconstruction of artefacts. From a theoretical perspective, the exhibition attempts to represent the philosophical principles behind the reconstruction of historical facts starting from the identification of archaeological artefacts, as discussed in Carr (2000). For instance, the children could open a series of cabinets and see, through a small window, different objects (metal and stone fragments) partially covered by sand. This exhibit is supposed to show to the children how artefacts look when they are discovered and the challenges involved in their identification. However, results from observations during a guided tour suggest that the children tend to go quickly through all the cabinets, sometimes playing with each other in groups, so that in the end it is not clear if they were able to grasp the complex meaning of the exhibition.

In conclusion, the challenge of transposing one specific historical process into a tangible interactive exhibit could provide interesting opportunities to explore how digital exhibits could support learning of history, and contribute to the physical layout of museum exhibitions. For instance, in Paper 5, it is argued that digital technologies can afford to show the dynamic aspect of historical processes through interactive media and compelling audio-visual feedback, in line with Lyons et al. (2015). Moreover, in Paper 2, it is argued that the interactivity of digital

[30] Interview in Ribe, winter 2010, see Paper 1.

[31] Quote from the head museologist of Ribe.

technologies could support playful interaction between children and guides, enabling them to engage in a dialogue while exploring together the historical meaning embodied in the digital exhibit. These reflections are used as basis for the design process, discussed in chapter 6.

5.3.2 Primary school children and history

Having established which approach to learning of history the two museums have adopted, the field study continued with investigating how this approach is perceived by young visitors. The data gathered during the field study confirm the literature (Hornecker and Sifter 2006) about young visitors' interest for tangible exhibits enabling for self-expression and playful interaction. In general, the children displayed a different behaviour during free tours and during guided tours, specifically in the way they engaged with the museum space. Ethnographic observations and short situated interviews were conducted in both museums and the analysis was based on field notes and interaction analysis on video material. Paper 2 and 3 discuss in details the different behaviour displayed by the children during free and guided tours. Paper 2 discusses findings in relation to Rogoff (1990) and her framework of apprenticeship, in order to define a new learning scenario for guided tours. On the other hand, building on Sutton-Smith (1997) and his theories about play and social interaction. Paper 3 discusses the same results focusing on the needs of individual children in combination with data from the participatory design workshops, with the goal of defining design requirements for the prototype.

During guided tours, it was noticed that children act as if during a lecture, they are usually quiet and do not address the guides directly. They address the guides mainly when raising their hands and answering to the guides' questions; as mentioned in section 5.1, this is considered a communication issue by the guides. Moreover, issues are elicited by limitations of space, especially in small local museums like Ribe. During guided tours, the children follow the guide and their teacher in small groups, in some cases the rooms are not large enough to enable all the children to see the artefacts at the same time, hence it can happen that only the groups on the front rows are able to see the displayed artefacts while the guide is talking about them; the groups on the back will see them afterwards. This causes disruption, especially for the children on the back, who might talk at each other and look at other artefacts. In general, the children displayed a disciplined behaviour during guided tours; they tended to be quiet until they were allowed by the guides or educators to play with the available tangible exhibits. Hence the children's behaviour changes from respectful and quiet to noisy and physically active, when the children are given permission to engage with tangible exhibits. In this sense, engagement with tangible exhibits offers the children a moment of relaxation from the cognitive effort of listening to the guides.

In Ribe and Coventry, visitors showed enthusiasm when they could engage freely and physically with tangible exhibits, as discussed in Paper 1. The individual visitors communicated with each other in a lively way, laughing and commenting at each other's actions, while for instance climbing on the Viking ship or sitting in an open fancy car (Fig. 18). It emerged that the visitors engaged in role-play, imagining themselves using the reproduced artefact in reality. For instance, two girls sat on the open car in Coventry and stroke cool poses addressing the other kids of their group, who were standing close to the car (Fig. 18). Similar behaviours were observed in Ribe, when the guide introduced the children to the Viking ship. They first sat inside the ship in an unordered way and then they looked and touched all the objects inside the ship, for instance, a girl tried on a fur stole (Fig. 18). The interactions observed were lively, several individuals were talking at the same time, and explored the different exhibits, so that it was difficult to gain a clear understanding of what the different individuals said on the video recordings. In both cases, the

Figure 18. Young visitors engaging with exhibits. On the left young visitors enjoy an open car in Coventry (Paper 1), on the right they play on the Viking ship displayed in Ribe.

guides had to recall the children's attention clapping their hands and raising their voice in order to continue the tour.

Observations conducted during two free tours, respectively in Ribe and Coventry, showed a different attitude in the way children engaged with museum space. During free tours, it became more evident that the children have different needs with respect to how they engage with museum space and tangible exhibits, as discussed in Paper 3. Some children formed groups and ran through the museum space. These children would look at the different artefacts, in some cases following the placement of the artefacts in the room, in others simply engaging with what they found in their way as if they were on a playground. Other children instead explored the exhibition by themselves in solitude and quietly. While I was observing a free tour in Ribe, a girl pointed at a black round area in the *Why Ribe?* exhibition and when asked why she liked it, she replied that: "it is nice" lifting her shoulders and smiling she continued saying: "I like it because I can be alone with my thoughts!" These results, which are discussed in Paper 3, are in line with Falk (2013), according to whom visitors access museums with different motivations and needs. Similar results were confirmed also by the studies of Hornecker (2008) and Hornecker and Stifter (2006) who analyse how differently visitors engage with museum exhibits, in relation to the emergence of different interactions and the time they spent exploring one specific exhibit.

Generalising from the gained data, tangible exhibits elicit a playful mood and opportunities for self-expression. At the same time, tangible exhibits contribute to the children's tendency to identify with the stories of people from the past, as discussed in in section 5.2.2 and Marchetti (2011b). Being able to sit on the Viking ship and wear a copy of a Viking Age garment can stimulate children's imagination and elicit forms of role-play, also granting opportunities for self-expression. These insights have two main implications, the first is that the current approach adopted by the two museums seems to meet the children's needs with respect to role-play and identification, the second is that the low-tech tangible exhibits observed in the two museums seem to support engagement and self-expression as well as digital exhibits. These implications reveal open issues in relation to what digital exhibits could add to young visitors' museum experience in terms of engagement and experience, despite the claims made by researchers (Lyons et al. 2015; Apostolellis and Bowman 2015; Dindler and Iversen 2009; Hornecker and Sifter 2006). It is also not clear if the children are learning something about history in the actual way they experience guided tours and tangible exhibits, and how digital exhibits could support learning of history; a central topic to this thesis.

5.3.3 Design requirements

Based on the findings from the field study, two main requirements emerged in relation to how digital exhibits should support learning of history inside the museum so to:

1. Represent historical processes from a diachronic perspective;
2. Support identification, role-play and self-expression.

Results from field study suggest that in order to contribute to museum learning practice from the perspective of museum practitioners and children, the design of digital exhibits should explore how to make use of the interactivity of digital technologies to represent historical processes from a diachronic perspective. In this way, digital exhibits will contribute to a more critical approach to history than the synchronic approach, which looks at history as a static sequence of facts. At the same time, the design process should respect the principle of authenticity, seen as an important criterion in museum learning practice according to the practitioners from Ribe. However, it was difficult to discuss in depth this principle with the curators, as if it was hard for them to define it in precise terms. Therefore, it was decided to investigate it through the design process with the help of children and guides and of historical references.

A convergence was noticed in the behaviour of children and guides, as the children tend to express forms of role-play and identification when approaching human remains and personal stories, at the same time guides recall through the exhibits how it could have felt to experience specific practices or events in the past. As discussed in Marchetti (2012), this convergence provides rich opportunities to explore how digital exhibits could support learning of history, facilitating forms of role-play and interactive storytelling, for instance through the creation of an interactive simulation, which according to Simon (1996), can support learning and sharing of meaning between experts and novices. This combination of role-play and storytelling has the potential of fostering reflections on everyday life in ancient times and comparisons between the past and the present, enriching current practices. This is in line with museum studies (Dysthe et al. 2012; Ritchhart 2007; Hooper-Greenhill et al. 2004) arguing that the goal of museum learning practice is to contribute to the education of citizens, who are aware of their cultural heritage and able to contribute to their community.

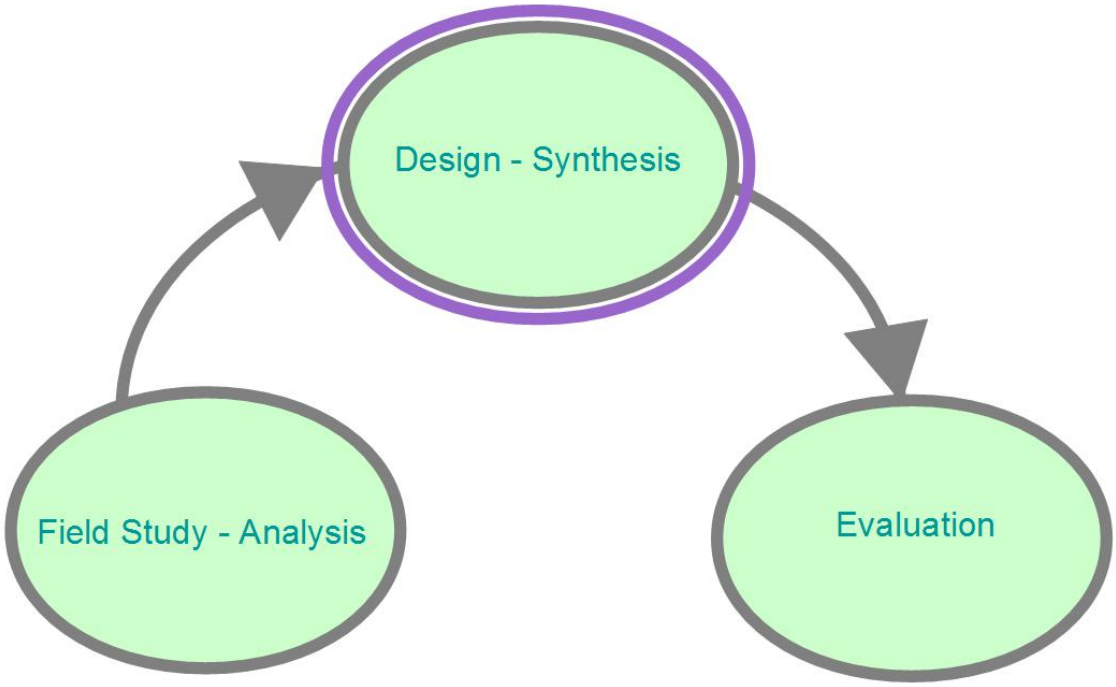

Figure 19. Stages of the study and highlighted the stage discussed in this chapter.

6. Designing for museum learning practice: the development of MicroCulture

Moving towards the synthesis/design stage of the study (Jones 1963) (Fig. 19), challenges emerged when the different insights and perspectives gained from literature and field study were to be integrated into the making of an artefact: a new digital exhibit aimed at enriching learning inside the Viking Museum in Ribe. Based on the results discussed in chapter 5 and in Paper 1, 2 and 3, three main goals emerged for the design outcome, such as to enable:

1. Children and guides to engage into a dialogue;
2. Children to experience history as a social process;
3. Museums to integrate digital technologies within their learning practice.

These goals are formulated to set a framework to evaluate the design process and its outcome in relation to the users' needs identified through the field study discussed in the previous chapter (5).

Figure 20. Low-fidelity prototype used during the 3rd and 4th participatory design workshops.

In the following sections, the design process is discussed starting with the development of MicroCulture (6.1) and then focusing on how the design process addressed the research questions. Section 6.2 discusses the making of the final prototype in relation to the macro level/organisational perspective. Section 6.3 discusses the prototype with respect to how it could enrich guided tour practice. The final section (6.4) explains how the foundation of Ribe was transposed into a digital exhibit.

6.1 The development of MicroCulture

MicroCulture was created through a series of four open-ended participatory design workshops (Table 4), each lasting for about two to three hours, and were held at the afterschool facility. The children were invited to design tangibles for a tabletop game about the Viking Age, without specific rules or restrictions. The workshops were based on the principles of participatory design (Druin 2002), with the goal of empowering children with respect to their museum experience, through the making of a new digital exhibit almost on equal foot with the researcher.

Even if this study applies an inclusive perspective addressing both the children and museum practitioners, the children are identified as having the most difficulties during guided tours in expressing themselves and in becoming active learners. Therefore, the children were involved as co-designers in the conceptualisation of the prototype. Since the guides seem to own a predominant position in the practice, they were involved in iterative testing. In this sense, the

design process ran on two parallel paths, where the children were involved as design partners while guides and curators were involved mainly as informants in iterative testing workshops (Druin 2002).

Table 4. Number of participatory design workshops and realised prototypes.

1st workshop (25/11/2010) **2nd workshop (24/01/2011)**	With design materials
3rd workshop (08/04/2011) **4th workshop (31/05/2011)**	With low-fi prototypes
7 prototypes	4 low-fidelity prototypes 3 high fidelity prototypes (including a technical trial)

As discussed in Paper 3 and in Marchetti (2011b, 2013), during the first two workshops, various design materials (Lego bricks, modelling clay, paper, and coloured pencils) were offered to the children to enable them to articulate their needs through the making of prototypes. During the third and fourth workshops, a low-fidelity prototype (Fig. 20) was presented to the children, together with sticky notes and coloured markers, to enable them to alter the prototype.

The goal of the participatory design workshops was to make sense of the children's perception of the Viking Age, what they could find interesting about the past, and how they would like to interact with the new exhibit. The workshops emerged as experiences of mediated shared thinking, in the terms of Wertsch (1991) and Rogoff (1990). During these workshops, the children engaged together in activities of shared thinking, coordinated by myself and mediated by the design materials, through which the children were able to express what they knew and could guess on the Viking Age based on previous experiences. Some children mentioned about having learnt about Nordic mythology in schools, through media, and conversations with their families, as according to Crowley and Jacobs (2002), and museum visits. The design materials worked in this way as mediational means (Wertsch 1991), allowing the children to engage in playful interactions socially or individually, and to imagine which objects could have existed in the Viking Age and how they could have looked like, and finally how they could play with the prototype when finished.

In this sense, the participatory design workshops can be analysed as another form of guided participation (Rogoff 1990), in which the designer sets the frame for the children who have to contribute to the preparation of a future activity. However, as the workshops are aimed at enabling the designer to learn about the children, while in the situation of learning guided participation is targeted at children's learning (Rogoff 1995), the typical asymmetries between partners in guided participation were reformulated in the terms of participatory design (Druin 2002). Hence, during the first and second workshop the children were left free to explore their ideas, as their only constraints were the goal of creating a game about the Viking Age and the provided design materials. The third and fourth workshop were aimed at building on previously collected insights, hence the children were assigned a narrower focus in relation to the actions

they were allowed to undertake, the materials accessible to them, and what to explore. In this sense, responsibility transfer (see section 3.3) was applied with an opposite trend than in learning, where children are constrained at early stages and given more independence as they progress (Wertsch 1991).

Mediational means, such as design materials and prototypes, set also a frame for creative and cognitive engagement, communicating implicitly to the children what they are supposed to do and which aspects they should focus on, at the same time eliciting conceptual thinking on how to alter the prototypes. The children interacted with each other through the given artefacts, they influenced each other when showing their newly made artefacts or when proposing ideas for the creation of new ones. In general, the children, created artefacts they liked: some were exploring combinations of different materials such as Lego bricks and play dough (as discussed further in section 6.4 and showed in Fig. 24 and 26). Other children instead might have created the usual objects they make when playing with the given materials. In this respect, the children approached the participatory design workshops as an interpersonal defined system (Rogoff 1990), from the perspective of their individual goals, the interaction emerging with the other children, and their sociocultural background of knowledge and experiences, which was expressed through their engagement with the materials and with the other individuals participating in the workshops. In this way, the children went through an appropriation process (Rogoff 1995) of the activities proposed in the workshops, showing glimpses of what they found interesting and of their understanding of the topic at hand.

In conclusion, the input provided by the children can be grouped into two main categories dealing respectively with: the content for the new exhibit and preferred forms of interaction. In order to enrich this inquiry, further workshops could have been run inside the museum and with less known design materials, to encourage the children in exploring their museum experience in more creative ways, according to the in-situ acting method (Yliriksu and Buur 2007). These insights will be, therefore, considered in future study and possibly in further development of the prototype.

6.2 Design and museum learning practice

This section analyses the design process addressing the main research question, dealing with how a design intervention could address the on-going shift.

The design process undertaken in this study does not aim at supporting one particular group of users, but rather the different users involved in museum learning practice. As a consequence, the design process takes into account how the on-going shift affects museum learning practice at a micro and macro level. Interviews conducted during the field study with practitioners from Ribe and Coventry provided the main source of data for this matter, hence gathered results refer to the perception of practitioners of this process from a subjective perspective. In fact, during the design process, the practitioners were not directly involved, but their input, which is presented in chapter 5 and Paper 1, was kept in mind in the development of the prototype. Museum practitioners were directly involved again during the preliminary and final evaluation of MicroCulture.

As discussed in Paper 1, museum curators perceive the shift as determined by external institutions, pressuring museums to become more productive and effective in managing their resources. At the same time, the digitisation of museum learning practice emerged as a mean to make museums more attractive to young visitors, as argued in Paper 1 and in related work (Janes

2009; Lang et al. 2006). However, the digitisation of museum practice is challenged by emerging issues, such as:

1. Practitioners' skepticism with respect to how digital technologies could contribute to museum learning practice;
2. Museums' limited funds;
3. External pressure on the freedom of museum practitioners to innovate.

The design outcome is supposed to address museums' needs from a micro and macro level perspective, respectively dealing with current practices and the role of museums within their professional network and community.

From a micro level perspective, the design of MicroCulture specifically addresses the emergent practice of innovation enclosures discussed in Paper 1 and chapter 5. The practice of innovation enclosures has emerged from curators' desire to innovate despite the limited funds and freedom imposed by external institutions, which on one side require innovation but in fact do not want to risk losing the advantages of established practices. As discussed in the journal article Paper 5, which reflects upon the creation of MicroCulture from the perspective of museum practitioners and their organisational practice, a scenario is proposed in which off-the-shelf, standard technologies and open source software are promoted, in line with studies like Hall and Bannon (2005) and their use of RFID sensors. Museum practitioners have expressed doubts regarding the prices and effective use of digital technologies and this thesis aims at showing that digital technologies can have advantages. For instance, off-the-shelf technologies can be bought at reasonable prices and are flexible, so that the same hardware can be reused in different configurations for new settings. In this way, digital technologies could contribute to the practice of innovation enclosures turning it into an iterative, exploratory practice, where costs would be loaded on software development. The creation of new software can in turn rely upon free or even open source development kits and upon the competence of organisations and large communities of developers, which could offer their expertise in different ways. In this respect, the design of MicroCulture aims at showing that digital exhibits are not necessarily more expensive than low-tech analogue exhibits, as the costs of purchasing new hardware can be limited by creating new reconfigurations reusing the same technologies for different exhibits. The costs for new exhibitions is acknowledged by curators as an issue, as even for small temporary exhibitions companies are hired and large amounts are spent for low-tech tangible exhibits that cannot be reused otherwise. As a consequence, if one of these exhibitions is successful it is kept open to visitors for a long time, with the risk of becoming obsolete and hindering the development of new exhibits.

Moving towards the macro level implications of the digitisation of museum learning practice, introduction of off-the-shelf technologies can enable museums to embrace tools and knowledge that are broadly spread within society, as argued in paper 5. Museums could open up towards cooperating with companies based on hardware that the museum practitioners have chosen. Moreover, museums could adopt user centred/participatory design methods, involving users in the creation and evaluation of new exhibits taking into account their needs and everyday interests, as suggested in Dindler et al. (2010). In this way, digital technologies might enhance the practice of innovation enclosures into a boundary object, creating a trading zone for communication, co-creation, and negotiation with potential partners and visitors (Star and Griesemer 1989).

Different technical setups have been considered for the development of the high-fidelity prototype, which was based on the low-fidelity prototypes made by the children during the participatory design workshops. The ideal setup included a large, interactive projection on the floor and a set of tangibles, to allow a large group of children to engage in mediated social play (Paper 5). However, this setup appeared inappropriate for museums' physical environment, as it is expensive, complex to install, and might require special maintenance. A simpler setup was instead created, adopting off-the-shelf technology to keep it inexpensive and easy to maintain. This final setup included a flat TV screen to be placed horizontally on the floor or on a table, a common high-definition webcam, and a dual-core processor laptop. The software was implemented in Python, using the Pygame game library and ReacTIVision (Keltenbrunner and Bencina 2007), an open source tracking system aimed at the creation of tangible interfaces. Python and ReacTIVision are both free and have a large community of developers and users, which guarantees an abundance of free online documentation. This means that once an exhibit like MicroCulture is adopted, the museum can freely engage in exploring what could be done with its components on an independent basis and together with different partners. Moreover, the same hardware setup can easily be reprogrammed to run many other historical simulations; the tangibles themselves and their meaning can also be redefined at will, since they consist simply of printed paper.

In conclusion, the setup was designed to enrich museum learning practice acting both on macro and micro level and bridging visitors and practitioners' needs. Summing up, the discussion above Table 5 points out how the design of MicroCulture connected together the research questions, the design requirements that emerged from the field study and literature, and the resulting design guidelines. Table 5 is aimed at recapitulating the discussions on the research questions, design requirements, and guidelines that have been articulated since the beginning of this thesis, from chapter 1 (Introduction) until the present section. In this way table 5 should provide the reader with an overview of how the design process is addressing the research questions. In general empowerment emerges as a main requirement, both from the perspective of the children and the museum practitioners involved. The museum practitioners need to be supported in seeing how they could make active use of technologies to support their everyday learning practice, where the adoption of off-the-shelf technologies is seen as resource to meet their administrative issues. The children on the other hand need to be supported in making active use of guided participation during guided tours, so that they could suggest different topics of discussion and interaction paths. Mediated role-play is in this respect envisioned as a resource to enrich the interaction between guides and children, enabling them to engage in a dialogue about historical processes.

Table 5. Overview on the mapping between the foci of research questions, design requirements, and the design guidelines resulting of the undertaken design process.

Research questions foci	**Design requirements**	**Design Guidelines**
1. A design intervention that could contribute to museum learning practice	**Empowerment**: Suggest a direction towards which practitioners could use technologies to take control on the digitisation of museum learning practice	**Off-the-shelf**: Economy and simplicity, popular, cheap hardware and free software development kit to emphasise flexibility and simplicity

2. The sociocultural factors involved in museum learning practice	**Participants**: Values, expectations, and needs **Museum environment**: Physical layout, meaning of the exhibition, use of environment in learning practices **Museum as organisation**: Administrative and practical matters dealing with the macro level of museum practice	**Tangible interface**: Provide support for mediated interaction **Contribution:** Fit within the museum space and the already present exhibits, contributing to the meaning of the exhibition **Economy and simplicity:** Take into account financial and administrative issues
2. Guided tour practice as a sociocultural activity	**Empowerment:** To enrich social interaction during guided tours and to enable children and guides to share control on the guided tour.	**Play**: Enable children and guides to play together and to engage in a dialogue
3. Learning of history inside the museum	**Role-play:** To transpose historical social processes into an interactive exhibit enabling children to experience how it felt to live in ancient societies	**Simulation:** Mirror social processes and elicit role-play, to enable children to explore how social change took place and how their actions can affect it

6.3 A tool for guided tours

This section analyses the design process addressing the 1st and 2nd research questions, dealing respectively with the sociocultural factors involved in museum learning practice and its shift, and with how digital technologies could enrich guided tour practice.

After having reconstructed an understanding of guided tours' practice (see section 5.1) from the perspective of the guides and the children, the next step in the empirical study was to investigate how the children would have liked to play with a digital exhibit about the Viking Age. Therefore, the 25 children from Oksbøl were invited to co-design a "tabletop game" about the Viking Age. As mentioned in chapter 4 section 4.2.3, during the first two workshops, the children were presented with different materials: (paper, coloured pencils, Lego, and play dough) and were asked to design the artefacts they would have liked to have in a digital game about the Viking Age. In my study I focused on analysing the artefacts made by the children and also on their social interaction, in situ, and through interaction analysis of video recordings.

The data gathered from the workshops are mainly discussed in Paper 3, included in this thesis, where the children's play is analysed as a complex ecology of playful interactions combining

forms of designerly, cooperative, and competitive role-play. Parts of the discussion of Paper 3 are also in the conference paper Marchetti (2012) and in the book chapter Paper 4. These two publications reflect on how the introduction of play could change museum learning culture. In Marchetti (2012), I argue that play can enable guides and children to engage in a dialogue, actively contributing to the storytelling practice taking place during guided tours. Paper 3 argues that through the emergence of this dialogue, the introduction of play could facilitate museums to shift from the modernist to the postmodern paradigm. Finally in Paper 4, I recall the results presented in Paper 3 to discuss how the children played with the final prototype in the museum.

Insights about how children would like to play with a game about the Viking Age emerged from the second set of workshops (the third and the fourth workshops), during which, a low-fidelity prototype made of cardboard was presented to the children, together with coloured markers and sticky notes, to enable them to make new tangibles and alter the prototype. Most children engaged with the low-fidelity prototype as if it was a board game that needed a preparatory stage, in which the tangibles had to be set up. The children created different tangibles for the settlement, such as houses and animals, but also weapons, tanks, bombs, and military ships. This preparation was conducted in a social form among some groups, as some children discussed with each other deciding what to do and where to place the tangibles. Afterwards, they were able to "play," meaning that they were able to engage in forms of role-play mediated by their tangibles.

An interesting case was represented by a group of two boys and two girls, who agreed to play together (Fig. 21-22: girl and boy on the front, see also Paper 3). They all started to setup their settlements at the opposite side of the given board, and then one of the boys said: "should we start playing?" where the word "playing" indicated that he did not considered as play the making of the tangibles in itself, hence after having made his tangible he was ready to play for real. Since the two girls did not reply to his invitation, he started to engage in role-play attacking the girl in front of him with a paper tank. In order to attack, the boy took a paper tangible he made representing a tank and waved it in front of the girl, as a provocation to fight (Fig. 22). In so doing, he would make aggressive faces, frowning, tightening his lips, and laughing in an arrogant manner. After a few minutes the girl was tired of his provocation and replied with decision: "stop, I am not ready yet!" They interacted in this way for a couple of times, in which the boy seemed to have fun attacking the girl, who in turn took her time with the other girl to finish up their settlement. After the girls decided that they were ready, the four children engaged in a form of competitive role-play, mediated by their paper tangibles.

This competitive aspect of children's play seems to combine the children's interest for the individual lives of people from the past and for forms of role-play. As it was noticed by the guides and observed during a free tour in the museum, the children showed interest for the people from the past (see chapter 5 and Marchetti 2011b). The children asked specific questions about who were the skeletons displayed in Ribe and, according to the guides, they sympathised with the life of medieval children as if they imagined themselves living as medieval children. In the observed cases, collaborative and competitive role-play enabled the children to imagine themselves as characters of their game, which was set in the past. In terms of design outcome, it means that role-play dynamics could be encouraged, in order to enable the children to detach from their reality (as discussed in Vygotsky 1968) and imagine how it felt to be alive at a specific historical time.

Other children, especially girls, preferred to spend their time designing new tangibles by themselves in a quiet way, sometimes communicating non-verbally to each other through eye contact, smiles, and lifting their tangible to show it to each other (Fig. 22 – front-left side of the table). For instance, as discussed in Paper 3, four girls engaged in making artefacts for the entire session, they created a settlement using the given tangibles and making new ones on their own. Moreover, after having explored their settlement for a while, they placed their newly made tangibles close to other players so that they could play with them (Fig. 23). This form of play is

Figure 21. Children engaged in in the making of tangibles for their play. The girls on the front, left side of the table are consulting each other on the matter.

Figure 22. On the right: boy waving a paper-ship to attack the girls and convince them to play. On the left: girl chasing the boy away with her own tangible.

Figure 23. Front: children engaged in competitive play. Back: girls engaged in playful play.

called in this thesis *designerly play*, taking inspiration from Cross (2006, p. 10) and his notion of "designerly ways of knowing." According to Cross, by engaging in the creation and manipulation of artefacts and of the environment, individuals become able to critically reflect on the characteristics of their artefacts and gain new knowledge about how these artefacts should be and fit within the environment. In this thesis, I call designerly play a form of play in which children combine role-play and the design of new tangibles to be later integrated in their own role-play. For instance, during the participatory design workshops, the children engaged in role-play with the given tangibles but also created new tangibles that they used in their own play. This form of designerly play afforded explorations of given and newly created tangibles, enabling the children to rediscover and discuss the characteristics of the artefacts reproduced in the tangibles and how they were used in the past. Building on Cross (2006) and Vygotsky (1978), a combination of designerly and role-play dynamics could enrich guided tours enabling the children to choose among two main different modalities of play (competitive and designerly), leading towards the children's active involvement to the guides' story telling activity, so that the children and the guides could discuss together about the ancient artefacts and the social processes reproduced in their play.

Moreover, some of the children made new artefacts for other children, as in the case of the four girls, their designerly play converged towards forms of playful play, in the moment they made new tangibles to support the other children's role-play and not their own, while other children engaged in designerly play made new tangibles for their own role-play. Playful play is in fact defined by Sutton-Smith (1997, p. 46) as a particular and rare form of play where creative individuals enjoy themselves defining rules of play for other players.

As the children combined these different forms of play, facial expressions, specific tangibles, and physical gestures provided vehicles to communicate specific actions and intentions in the on-going play. For instance, in order to attack other players, the children provoked each other. They

established eye contact making aggressive facial expressions: frowning, tightening their lips, and laughing arrogantly, while placing with a strong gesture tangibles of weapon or military vehicles in front of the other players (Fig. 22). Instead, while engaged in designerly play, the children placed different kinds of artefacts in front of each other with calm gestures and without any additional communication signs (Fig. 23). Facial expressions and quality of gestures during mediated play were, therefore, important external resources of communication and shared thinking, in which internal goals and feelings are conveyed among the individuals involved, in line with Rogoff (1990).

Summing up, the insights gathered through the children's play in the design process provided specific guidelines in relation to how to create a new digital exhibit aiming at enriching guided tour practice, such as:

1. Support mediated play and dialogue through a tangible interface;
2. Support both designerly and competitive role-play.

This means that the design outcome should include tangibles to be exchanged among the players and that it should not force the players into choosing one or the other form of play, supporting a free exploration of both. However, this study does not aim at turning guided tours into pure play, but at inserting "moments of play" within the guided tour (Marchetti and Petersson Brooks 2012c, p. 2) in order to enable the children and the guides to get acquainted and engage in a dialogue, contributing to the story being told.

In conclusion, these guidelines are not distant from Hornecker and Stifter (2006), who in their analysis of the digital exhibition, medien-welt discovered that tangible interfaces supporting social play and cooperative problem solving met the visitors' needs for social activity and dialogue with each other. In this sense, this thesis expands Hornecker and Stifter's claims, stating that tangible interfaces should support free exploration of different forms of interaction and play, in this specific case designerly and competitive role-play emerged as central to support social interaction and engagement for the children.

6.4 A transposition of history

This section focuses on the last research question, one of the main goals of the design process discussed in this thesis is to enrich learning of history, exploring the possibility to create a tangible representation of historical processes, which is acknowledged as a challenge by museum curators from Coventry and Ribe (see Paper 2 and chapter 5). Taking inspiration from Carr (2001), the new digital exhibit should represent history as a social process through an exemplary case that meets the interest of the children as well as the focus of museum learning practice. I identified this case in the foundation of Ribe, which is of central interest for the museum of Ribe.

Through the first two workshops, it emerged that children's interest for the Viking Age is associated to natural history, human life, settlement culture, and Nordic mythology (Marchetti 2011b). These interests were expressed through the emerging conversations and the artefacts that the children made during the workshops, which included: animals and human beings, giant babies, but also trees, houses, and infrastructures among which bridges, streets, and defensive walls (Fig. 24). During the first workshop, a playful conversation started about which animals lived in Denmark in the Viking Age, when a girl asked: "were there lions in Denmark in the

Figure 24. Artefacts made by the children during the workshops.

Viking Age?" At the same time the other children were shaking their heads ironically emphasising their disapproval. As I answered: "maybe not, but there could have been different animals around here than there are now," the other children laughed and some were also modelling a lion out of play dough. Hence she and other children went on asking: "were there tigers? Or snakes?" At that point I proposed to make the Midgard Serpent, a mythical water snake, who is famous for his fights against the god Thor. The children were thrilled by the proposal and started to add details to show-off how much they knew about the character. A boy said: "yes, the one who is surrounding Midgard with his body!" and then a few children said something about his fights against Thor, although their statements were not all clearly understandable in the video material. The boy, who mentioned that Midgard Serpent surrounded Midgard with his body, said that his favourite book at home was about Nordic mythology and we had a conversation about his favourite stories.

This interaction can be interpreted as an instance of the performative behaviour identified by Crowley and Jacobs (2002) in children who already have an interest in a particular subject. These children use the museum as an arena to perform in front of their parents, showing them how much they know about that subject, sometimes criticising the explicative signs provided by the museum. In the case discussed in this thesis, the children performed through the participatory design workshop and their prototyping activities, having conversations, and creating many different representations of Midgard Serpent (Fig. 24). In this respect, data from the workshops suggest that interesting design opportunities could be found in the combination of Nordic mythology, play, and learning in order to enable the children to become active participants in museum learning practice, showing themselves as proud knowledgeable individuals.

As discussed in Paper 3 and in Marchetti (2011b), in order to explore further children's interest for living beings, I introduced a few extra materials for the second workshop (Table 4 in section 4.2.3 entitled *Design Process*), such as: different Lego bricks, including a robot from the Byonicle series, and a set of cut out characters drawn as if they were seen from the top. These characters included males and females dressed like in the Viking Age and at different stages of their biological life: children, adults, elderly, and skulls (Fig. 25). The skulls elicited lively responses and were found "cool" and "fun." The children used the skulls in their creations. For instance, several children made cemeteries or used the skulls to mark abandoned areas in their settlements. Only one girl complained that the skulls made her think that one day she will die too. This opens up ethical reflections, in relation to showing the biological life cycle in a sensible way, so that death is

Figure 25. Cut out characters at different ages: children, adults, including a mother with a new born baby, elderly and finally a skull, representing the death of an elderly character.

Figure 26. Artefacts made by the children, quest against the Kraken, represented by the Lego Byonicle (Marchetti 2011b).

not represented in a dramatic way and the children could easily drive their attention to other elements while playing.

During the second workshop, the enthusiasm for Midgard Serpent continued, the children made more exemplars of the characters and mixed the given items in original ways. A girl created a whole narrative, in which the player is supposed to go through four rooms: a starting room, two rooms with several Midgard Serpents to kill, and a final room where the player has to kill the Kraken, represented by the Lego Byonicle. If the player fails to kill the Kraken, he or she would die and go back to the third room, where a cemetery is located for the heroes who failed the quest. If the player wins, then he or she could access the Valhalla (Fig. 26) (Marchetti 2011b).

All these insights gathered from the children's play and prototyping activities were used as the basis for the design process, so that more precise guidelines emerged for the design of MicroCulture, such as:

1. To reproduce the natural environment of Ribe;
2. To introduce a population with a life cycle where death happens but it is not too emphasised;
3. To introduce mythological elements that that the children might know, to help them in gaining pride and engaging in a dialogue with the guides.

In order to represent the foundation of Ribe in a playful and interactive form, I looked into relevant historical and archaeological literature. In this literature review, it was found that the origin of urban settlements is connected to the kings' act of placing infrastructures on a specific portion of their land (Jensen 1991; Schmidt 1991). The foundation of Ribe belongs to this case. Ribe was initially a seasonal market place and its development started in 700 when King Godfred divided the market area into predefined lots that could be rented to the merchants. In this way, the king could collect taxes and enrich himself from the market trading. The merchants in turn developed a sense of attachment to their lot and moved to Ribe on a permanent basis (Jensen 1991). This was a major change for the market place, which was transformed into a rural village. The village grew and got more infrastructures built by the following kings, such as bridges and wooden paved streets, to enable the peasants to overcome the difficulties of living in an area characterised by swamps and woods. Finally, during the second half of the 10th century, the village became officially a town, when it was restructured and fortified under King Harald Bluetooth (Jensen 1991; Schmidt 1991).

The story of Ribe was approached from a simulative perspective. A simulation is intended in this thesis as an artificial object that imitates specific phenomena or aspects of reality, so a simulation "can be organised to exhibit nearly identical behaviour" to real phenomena "despite having different internal organisations" (Simon 1996, p. 13). A simulation is also a technique for "achieving understanding and predicting the behaviour of systems (which) predates the existence of computers (...). The digital computer has extended the range of systems that can be imitated" (Simon 1996, p. 13). This aspect can be seen in museums where low-tech installations are adopted to imitate environments and artefacts of the past. Digital technologies, however, offer new possibilities for the creation of tangible simulations targeted to museum learning practice. A simulation is also a partial representation of a phenomenon, focused on key elements and dynamics, as it only embodies the knowledge that its creator possesses. In this respect, it seems illogical that a simulation could be the source for new knowledge to its creator, yet a simulation offers precious insights as it enables its creator and users to see more clearly the implications of its premises and to analyse and compare the different aspects and dynamics of the simulated

phenomenon (Simon 1996). In this way, Simon's understanding of computer-based simulations provides an interesting perspective in relation to the role of digital technologies in learning practices.

Since a simulation is by definition partial, the first step in the making of my prototype was to analyse the core elements identified by historians in the development of Ribe and coherently transpose them into features of the simulation, such as: narrative framework, environment, characters, and tasks for the players[32]. The tasks in the simulation acquire meaning in relation to the gameplay, its narrative framework, and the transposed knowledge, strengthening the link between the represented phenomenon and players' actions in the simulation, such as: placing infrastructures to favour the development of a settlement in reality and in the simulation. Following Rogoff (1990) these tasks can in this way provide goal-directed activities, in which the children and the guides can both engage, hence, turning the players into active characters in the simulation, as their actions are essential in making the simulation work and show the interplay between its different features. The role of the players as characters in the simulation is also supposed to foster the emergence of role-play, which has been identified as a key aspect in the way children like to look at the past according to findings from the field study (see section 5.3.2).

Following historical and archaeological studies, the placement of physical infrastructures performed by the kings was identified as a central factor in urban development. The kings' territorial actions have complex implications for the peasants living on the site. These actions were a form of mediated interaction between the kings and the peasants, who did not necessarily have any other close contact (Tabacco 1974). Infrastructures allowed the peasants to overcome natural obstacles, as swamps and woods can be turned into streets and rivers can be bridged, enabling the peasants to explore the territory and expand their village. In this sense, the birth of Ribe can be analysed as the emergent results of a complex interplay between the peasants and the kings, and between the peasants and the materiality surrounding them, which included social forces, artefacts and technological achievements, and natural and human made environments (Carr 2001).

The prototype resulting from the complex design process discussed in this thesis is called MicroCulture (Fig. 27-28). This name is based on a biological metaphor, suggesting a scenario, in which the children and the guides together conduct experiments on a microscopic "culture." MicroCulture is a computer-based simulation created to support children and guides to explore together the key elements and dynamics involved in urban development and their implications. The simulation represents a territory modelled after the site of Ribe and a population where the individuals are born as children, grow old, establish their own households, have new children, and then grow old and die (Fig. 28). The simulation is interactive as the players can affect the landscape and the population by placing a series of tangibles. These tangibles represent four different infrastructures: a bridge, a wooden paved street, a section of a round rampart, and a market fence. The simulation is attempting in this way to mirror the interplay between the kings, the peasants, and the materiality surrounding them in a simple way. For instance, when a player places a bridge tangible on the map (Fig. 29), a bridge appears in the simulation at the position of the tangible and with the same orientation, and the newly created bridge enables the characters to cross a river and reach other areas in the landscape. Similarly, the street tangible can be used to convert woods or swamps into a planked walkway and to enable the characters to walk and build a house or shop in the street proximity. The market fence and the rampart tangibles can affect specific areas, the market fence can turn woods into a delimited market place, represented as a brown patch of land with shops and new characters, the rampart can instead be used to protect

[32] This approach was generalised in a later article published by The International Journal of Arts and Technology (Valente and Marchetti 2013).

Figure 27. High-fidelity prototype of MicroCulture in the museum (Paper 5).

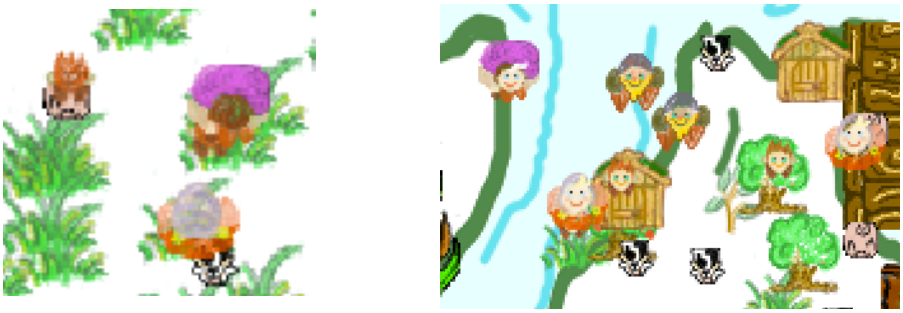

Figure 28. Simulation characters while the simulation is running (left) and while an infrastructure is being placed (right) (Paper 5).

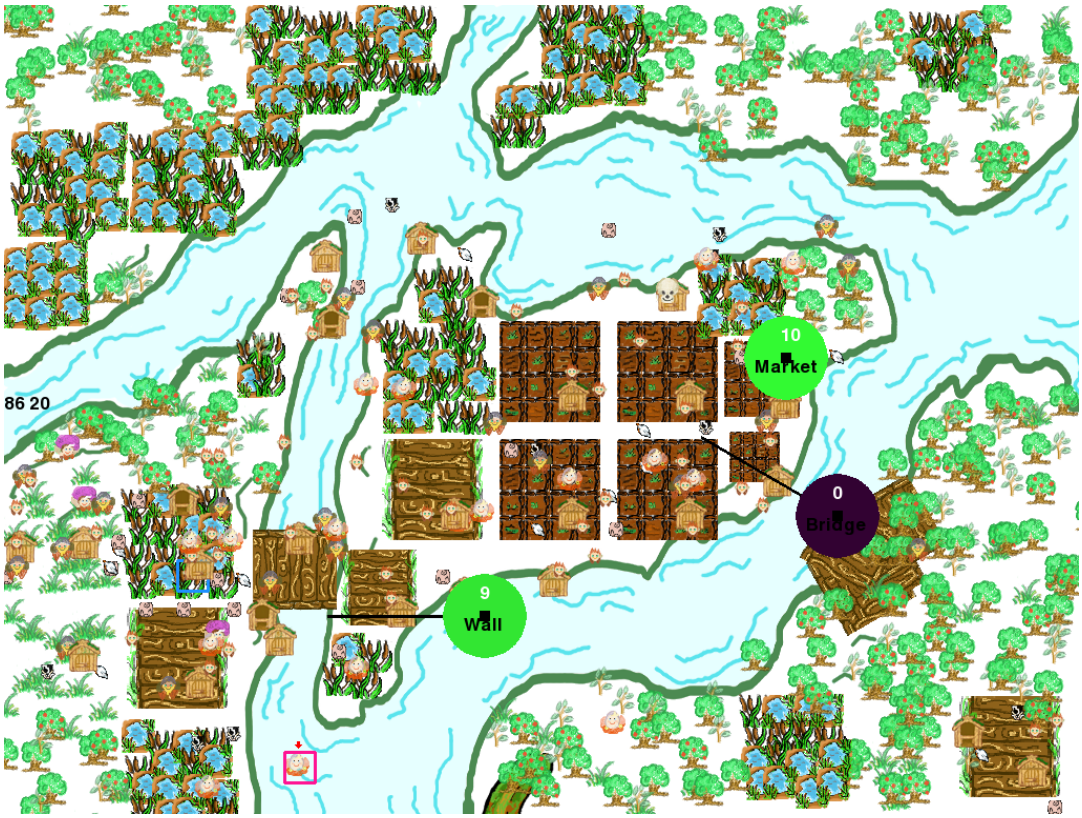

Figure 29. Screenshot of the simulation showing the placement circles (Paper 4).

the settlement, preventing the characters to move towards a certain direction. Therefore, when the players place infrastructures, they affect the behaviour of the characters, who in turn can be allowed to overcome the limitations imposed by their territory, or can be attracted to construct new buildings close to the paved streets and bridges, but can also be prevented from reaching certain areas.

The infrastructures represented in the simulation were modelled after real Viking Age constructions that were made of wood and turf. The streets were copied from the wooden planked streets that were constructed in Ribe during the Viking Age. The circular ramparts were inspired by the walls that Harald Bluetooth had built around Ribe and the Danish fortresses (Schmidt 1994).

Audio-visual feedback is provided while the players are placing tangibles on the screen. A placement circle appears under the tangible, which changes colour from white to green and black and then it disappears when the desired infrastructure is drawn in the simulation (Fig. 29). The circle shows the precise location and orientation of the desired infrastructure, this is particularly important for bridges and ramparts that are used to link two locations and to protect a particular area. This direction is indicated visually by a line centred in the circle (Fig. 29), so the players can adjust the infrastructure according to their needs. During the few seconds it takes for the infrastructures to be built in the simulation, a hammering noise can be heard while the voices of the characters, which can be always heard through the simulation, are silenced. Furthermore, when a tangible is placed, the characters raise their head looking at the players, while normally their face is not visible (Fig. 28). In line with Lyons et al. (2015), this feedback has both a functional value and sociocultural meaning as it is aimed at confirming that the players' actions have been correctly detected by the system, providing a compelling representation of the construction works. At the same time, this feedback symbolises the communication aspect of the

territorial acts of the kings and that the peasants are being affected by his territorial acts, as discussed in archaeological literature (Tabacco 1974).

It is historically documented that, in order to support urban development, kings or noble landlords had to be committed to their land, be willing to use resources to gather workers and construction materials, and also maintain the infrastructures in a well-functioning state through time. For this reason, all the infrastructures created in the MicroCulture simulation age and after circa one minute they disappear. The disappearance of infrastructures affects the behaviour of the simulation and of the characters. For instance, when a bridge disappears after circa one minute, the landscape appears as it was before the bridge was placed, so to simulate that the woods and the river have taken over the human work and the characters cannot cross the river anymore. Similarly, when placing a street tangible, the players act as if they were cutting woods in a forest and enable the characters establish more houses. After circa one minute the street disappears, but if enough characters have homes and walk frequently on a wooded area previously occupied by a street, the trees do not grow back. If the wood grows back, the peasants cannot build new houses on that area, unless a new street is built. This means that the characters are again constrained by nature and dependent on their kings. If the king does not rebuild the needed infrastructures, the characters would move away and decrease in number. This set of rules was created in order to provide the players with indirect and implicit control over the territory and the population, as outlined in Paper 5, so to motivate playful explorations suggesting an experimental setting in which grounding mechanisms have to be discovered.

The MicroCulture simulation embodies complex meanings that the children alone cannot grasp, but differently from other digital exhibits, like the Tree of Life Table (Hornecker 2008) or the different installations discussed by Ciolfi (2012) or Lyons et al. (2015), MicroCulture is not supposed to be a stand-alone and self-explanatory installation. On the contrary, the simulative approach embodied in MicroCulture is contextualised within a framework of apprenticeship in thinking, where the guides are in charge of facilitating the children in grasping the meaning of the simulation. As acknowledged in some studies like Apostolellis and Bowman (2015) and Ciolfi (2012) guides can play a fundamental role in enabling children to discover the grounding mechanisms of the simulation as well as their historical meaning in relation to their interest and learning needs. Therefore, differently from the mentioned studies which did not specifically target guided tours, MicroCulture was designed to be in Rogoff's terms (1990) a mediating tool to support guided participation, communication and meaning making, negotiation of interaction rules. Moreover, MicroCulture was also aimed at mediating between the past and the present, between present reality and hypothetic reflections on history that could emerge in the players' mind, as argued in Paper 2 and 4.

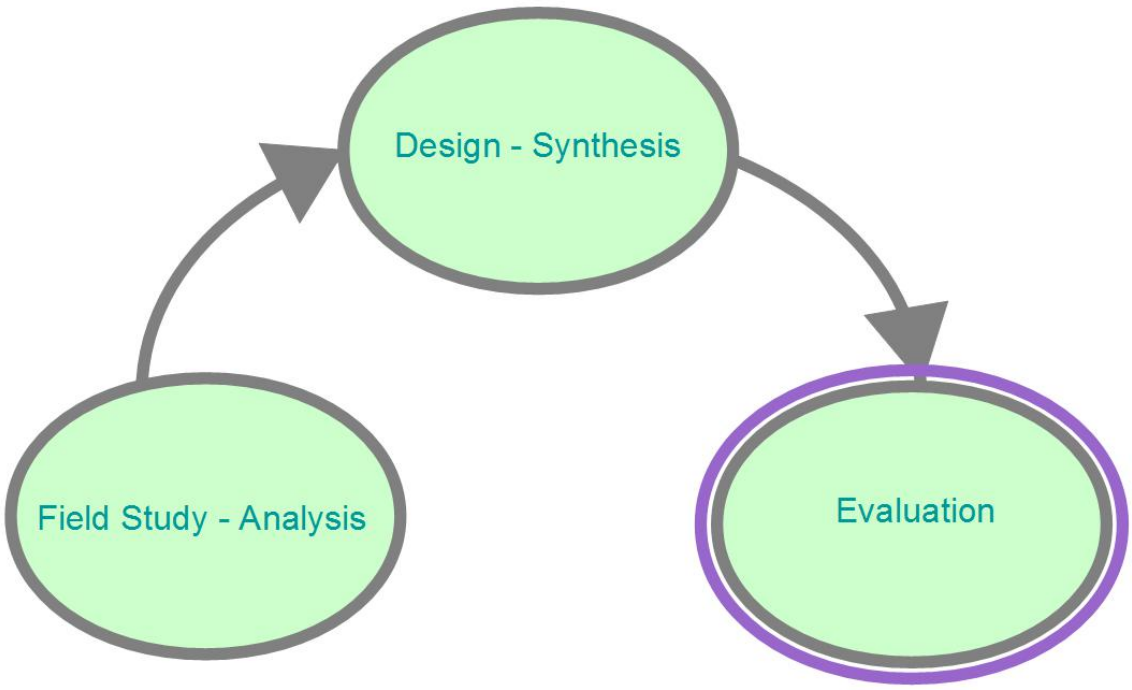

Figure 30. Maps of stages of the study: Evaluation.

7. Discussion. Reflections on the final evaluation of MicroCulture and the research questions

A lot has happened since the beginning of the study (the preliminary survey was conducted in 2010), digital technologies have become more present also in local museums, as testified by some of the latest studies in interaction design (Apostolellis and Bowman 2015; Lyons et al. 2015; Iversen and Smith 2012). Moreover, new interdisciplinary understandings of museum learning practice have emerged in museum studies (Roberts 2015; Hosker et al. 2014; Ciolfi 2012). These new developments show that learning practices are not static objects but dynamic sociocultural activities, which go through changes determined by internal and external influences as it was already discussed in literature (Dysthe et al. 2012; Lang et al. 2006; Rogoff 1995).

Taking into account recent developments and data from two new conclusive interviews conducted with the curator and museologist from Ribe, this final chapter discusses the research contributions provided by this thesis, the related empirical work and the included articles (Fig. 30). As already discussed in chapter 1 this thesis and the related study provide a theory and a practice-oriented kind of contribution. The theory-oriented contributions represent the knowledge contribution of my study and it includes the following three points, which will be unfolded further below:

1. Inclusive framework bridging micro and macro level discourses on museum learning practice and its shift;

2. New knowledge and understandings of museum learning practice and guided tours as sociocultural practices;

3. New knowledge about the role of digital technologies within museum learning practice, guided tours, and learning of history inside the museum.

The first theory-oriented contribution of this thesis is a new inclusive framework to study museum learning practice. This framework builds on sociocultural theories (Rogoff 1990, 1995; Wertsch 1991; Vigotsky 1978) and on an interdisciplinary perspective combining museum studies, interaction design, and specific studies on guided tours. On a more practical level, it was possible to formulate this framework involving the key participants of museum learning practice, such as visitors, curators, and guides. This framework is aimed at bridging micro and macro level discourses, supporting a more comprehensive understanding of museum learning practice and the design of new digital exhibits. Through this framework museum learning practice is seen as sociocultural activity unfolding through Rogoff's (1995) three planes: a personal and interpersonal plane dealing with social interaction among individuals and daily practices, and the community plane dealing with the social interaction between museums as organisations and other socio-political organisations and also with their surrounding society.

This framework represents a further development to reflections that were conducted in different works. For instance the work of Mason (2015) and Roberts (2014) look at the design of new digital exhibits as an interdisciplinary field combining knowledge from museum studies and design in the moment designers start cooperating with museum practitioners. Similarly Hosker et al. (2014) point out that interdisciplinary perspectives are needed also within the practitioners operating within the same museal institution to discover new opportunities, including the role of digital technologies. Furthermore, Ciolfi (2012) argues that she has adopted an inclusive approach towards the involvement of visitors and stakeholders in the design of new digital exhibits. In my study I contribute to combine and deepen these existing perspectives identifying the fragmentation between micro and macro level discourses, which represents a specific area of applications for the inclusive framework. Moreover, in my work I see the interdisciplinary perspectives proposed in the mentioned studies as a precondition to the articulation of the inclusive framework that is proposed by Ciolfi and articulated further in my own thesis. Hence, in my thesis this inclusive framework is more explicitly formulated through a sociocultural grounding and is given the specific aim of bridging micro and macro level discourses in the study of museum learning practice and its shift, in order to support more effective design interventions. This framework also answers to my main research question, which aims at investigating how a design intervention can contribute to the shift in the role of museums, providing a theoretical perspective to contextualise the design process within museum learning practice and the needs of the participants. Paper 1 and 5 included in this thesis give relevant insights to the formulation of this framework. Paper 1 discusses new insights on the on-going shift and on the sociocultural factors involved in museum learning practice and its digitisation, specifically addressing the main research question and the first sub-question. Hence this first paper is building on the data that I have gathered about how museum practitioners' perceive the on-going shift, the integration of digital technologies within the museum, and emergent strategies like the practice of innovation enclosures that museum practitioners have adopted to deal with the shift. Paper 5 on the other hand analyses from the perspective of cultural and social capital, how the integration of digital technologies within museum learning practice can empower museums as organisations, in re-gaining control on their shift. These papers discuss data that were gathered during the field study and the design process, hence these papers are also discussed in chapter 5.

The second theory-oriented contribution of this thesis is a new understanding of museum learning practice and guided tours as sociocultural practices. Analysing museum learning practice and guided tours through the inclusive framework proposed in this thesis, new theoretical knowledge has been provided in relation to investigating museum learning practice and the sociocultural factors that affect how this practice takes place and its innovation. Through this perspective museum learning practice appears as a complex activity defined by its sociocultural context, values, and interactions among the participants with their different interests and background. These insights contribute to answer to the first sub-question dealing with the sociocultural factors affecting museum learning practice and its digitisation. Paper 2 proposes a new playful learning scenario for guided tours, with the goal of turning guided tours from a lecture into a playful, participatory apprenticeship, in which guides and children could engage into a dialogue. The mentioned insights represent addition to the current research on guided tours such as Best (2012), Dysthe (2012), Pierroux (2010), and Ritchhart (2007). In this respect my study brings new knowledge in relation to the understanding of museum learning practice and of guided tours, which are said to be little studied (Best 2012). Moreover, Best describes the guided tour as an interactive activity, which could be enhanced by digital technologies. Through my study I found that the interactivity of the guided tour is hindered during school tours, as the children relate to the guided tour as if it was another school lecture. In this way my study identifies specific issues that are challenging the practice of guided tours, contributing to the knowledge of this practice and pointing at specific issues that could be taken into consideration in design practice. Moreover, as the studies of Pierroux (2010) and Ritchhart (2007) tend to focus on the approach used by the educators to engage with the visitors and elicit learning, my study also provides knowledge about how the visitors relate to museum learning practice and the guided tour. Since Paper 2 suggests a scenario for the creation of MicroCulture, the knowledge contribution provided by this paper is also discussed in chapter 6 in relation to the design process.

The third and last theory-oriented contribution includes new insights on the role of technologies within museum learning practice, the guided tour, and learning of history from the perspectives of both micro and macro level discourses. Hence this last theoretical contribution addresses the second and third sub-questions, dealing respectively with the role of digital technologies in enriching the guided tour and learning of history inside the museum. My study discusses new knowledge in relation to how digital technologies could contribute to guided tours, enriching the social interaction emerging between children and guides through forms of playful learning supported by mediated play. Mediated play is seen in this thesis as a resource for learning and social interaction. Building on Vygotsky (1978) forms of mediated play are seen as enabling children in reflecting on an abstract level on their action and on the implications of such actions in their play. Moreover, following Rogoff (1995, 1990) learning is analysed in this study as a process of appropriation or becoming, in which learners change and become more prepared for similar future activities. My study provides new knowledge about how forms of mediated play can literally support this process of becoming, as in their play the children can imagine themselves as living in a different historical period, reflecting on how different their life could have been. Moreover, mediated play is also seen as a resource for social interaction and the empowerment of the children, as in line with Sutton-Smith (1997) mediated play children can alter their hierarchical relationships with adults and become able to take charge of their play. Similar cases are reported also by Rogoff (1990), in this way I expect that mediated play can empower the children enabling them to choose their own actions during play and engage in a more symmetric dialogue with the guides. These insights are mainly discussed in Paper 3 and 4. Paper 3 discusses results from the participatory design workshops conducted with the children and provides new knowledge about how digital technologies could support the emergence of a rich ecology of mediated play in which different forms of tangible and playful interactions can coexist. In this respect the insights discussed in Paper 3 provided a basis for the design

requirements for the making of MicroCulture and are discussed also in chapter 6. Paper 4 is a book chapter focusing specifically on the analysis of the video material gathered from the evaluation. The paper is aimed at investigating how the introduction of a tabletop, digital exhibit could affect guided tour practice and the historical discourse taking place between the children and the guides from a micro level perspective. At the same time, Paper 4 investigates from a macro level perspective the implications of introducing mediated play within museum learning culture. More specifically, Paper 4 argues that mediated play could support children in gaining control of their learning and in reflecting about history, promoting the on-going shift from the modernist to the postmodern paradigm. Marchetti and Petersson Brooks (2012c) also reflects upon the results gained from the final evaluation of MicroCulture, but in comparison to another study conducted by my co-author. This paper argues that the design of learning technologies can benefit from creating conditions for learning and dialogue to freely unfold among the participants. At the same time, the emergence of confusion in the participants, caused by the lack of precise guidelines, enables the participants to redefine their own interaction and create new scenarios for their learning and for the use of newly created technologies. In this sense, Marchetti and Petersson Brooks (2012c) represents a follow up and an extension of the discussion conducted in Paper 3 and 4. Paper 5, the last included in this thesis, lifts the discussion conducted in Paper 4 to a broader perspective, combining macro and micro level discourses. In this paper, a new scenario is proposed, in which the digitisation of innovation enclosures could provide an opportunity to designers to contribute to the on-going shift in the role of museums supporting the emergent practice of innovation enclosures. At the same time Paper 5 envisions how through the acquisition of off-the-shelf technologies museums could shape a new role for themselves within society, leading cooperation with other organisations, which could provide the expertise that museums lack. Technologies could function as boundary objects enabling museums to engage in cooperation with other organisations where they could borrow the expertise that museums lack. As a result this paper provides insights about how digital technologies could re-shape how history is told in museums, so that instead of a lecture where facts are listed by the guides to the children, historical processes can be experienced through social forms of mediated play by the participants. This approach would be more in line with the understanding of history of eminent scholars like Carr (2001). This contribution represents an addition to the work of Muratsu et al. (2014), Lyons et al. (2015), Roberts et al. 2014, Muise and Wakkary (2010), who discuss the design and evaluation of technologies aimed at supporting an activity in which the visitors engage on their own while being at the museum. My study instead provides new insights, in relation to how the design of digital exhibits could contribute to the activities that are offered by the museum to the visitors, more specifically the guided tours. Moreover, my study specifically target learning of history, where studies like Muratsu et al. (2014) and Lyons et al. (2015) focus on the sciences.

These mentioned theory-oriented contributions and the design process undertaken for the empirical work discussed in this study have brought also three practice-oriented contributions, which include:

1. The creation and evaluation of the interactive installation MicroCulture;

2. New knowledge about the guided tours;

3. Insights on how digital technologies can affect learning and social interaction during the guided tours.

The first practice-oriented contribution gained from this thesis is the creation and evaluation of MicroCulture (Fig. 30), the new digital exhibit that I have designed and that is aimed at enriching

guided tours and learning of history inside the museum. The design process has provided new knowledge, in relation to which design requirements can emerge when designing targeting guided tour practice and to how a digital exhibit could enrich guided tours. In line with Zimmerman et al. (2007) MicroCulture is seen as an exemplar of the conducted study, embodying the insights that I have gained through the field study and the design process. The creation of MicroCulture constitutes a consistent thread through all the papers I have published during my PhD, as all the data I have gathered through my study were analysed in terms of finding requirements or evaluating MicroCulture. However, Paper 2, 3 and 4 more explicitly refer to the exhibit, as Paper 2 proposes a new scenario for its use, Paper 3 focuses on design requirements gathered during the participatory workshops held with the children and Paper 4 discusses the evaluation of the high fidelity prototype during guided tours conducted inside the museum. In terms of research contribution the design of MicroCulture represents an interesting case as it addresses learning of history during guided tours, when interaction design research has focused mostly on investigating the science museums and in addressing the activities that visitors independently engage in and not the ones offered by museums (Lyons et al. 2015; Muratsu et al. 2014). Interaction design studies addressing historical heritage also tend not to look into guided tours, but aim at making curatorial practice more open and participatory (McCaw et al. 2015; Ciolfi 2012; Iversen and Smith 2012). In this respect the design of MicroCulture is contributing to understand how a design process can address the practice of guided tours, which are an integral part of museum learning practice, but have received limited attention as according to Best (2012).

The second practice-oriented contribution is represented by new knowledge on how the guided tour takes place, how children relate to the museum space and their play. In this respect I have gained concrete knowledge about how guides and children interact with each other and with the museum environment, which include ancient artefacts, eventual digital and non-digital exhibits, and the usual routines that are involved in the guided tours. Analysing the practice of guided tours through my inclusive perspective I contribute to the study of museum learning practice and of the guided tours combining the perspective of both visitors and guides, where researchers have often focused on the role of the educators with respect to the contribution of museum to their society as Ritchhart (2007) and Pierroux (2010). At the same time since the gained knowledge is aimed at the design of a new digital exhibit, I contribute to the understanding of how digital technologies could enrich the guided tours, which according to Best (2012) is needed in order to align guided tour practice to the needs of the contemporary young audience. The mentioned contributions are discussed in Paper 1 and 3 included in this thesis, and in Marchetti (2011a, 2011b). Paper 1 and Marchetti (2011a) focus on how guided tours take place inside the museum, for instance discussing how guides try to engage in a dialogue with young visitors addressing the displayed artefacts and exhibits. Paper 1 also analyses in details how guides or educators refer to artefacts and tangible exhibits to tell their story, wherein I identify challenges in the fact that museums use artefacts to convey knowledge about history from a synchronic perspective, while the diachronic perspective is only conveyed through less engaging verbal narratives. In this way I contribute to Ciolfi's discussion (2012) about how educators make alive the exhibition for young visitors. These insights also contribute to the understanding of how historical knowledge is taught inside the museum to young visitors, coupling a sociocultural perspective that is already present in the studies about the art museum such as Dysthe et al. (2012), Pierroux (2010), or Hooper-Greenhill (2000, 2004) with the interaction design perspective that is present in studies that touch the guided tours only to a limited extent (Apostolellis and Bowman 2015; McCaw et al. 2014) or focus on innovating curatorial practice (Ciolfi 2012; Iversen and Smith 2012). More specifically Apostolellis and Bowman (2015) acknowledge the benefit of guided tours in visitors' learning gains. Instead McCaw et al. (2014) and Dindler and Iversen (2009) briefly discuss the limitations of guided tours, respectively pointing out how guided tours only appeal to a limited group of visitors, mostly mature women, and both studies analyse how guided tours impose limitations on how the visitors can engage with the exhibitions.

On the other hand, the insights gathered on how digital technologies can provide new ways of representing historical knowledge through interactive simulations, is a new application of the discussion of Lyons et al. (2015) about how digital exhibits should provide the visitors with guidance in exploring the problem space through the elements of the interface and meaningful feedback. Paper 3 and Marchetti (2011b) instead focus on the perspective of the children. Paper 3 analyses data from the participatory workshops reflecting on how differently the children bridge their experience of museum space with their play, for instance in their needs for solitary or social engagement. Marchetti (2011b) finally addresses how children relate to historical knowledge, investigating questions such as: what do they know and what do they find interesting, where I argue that children are knowledgeable about Nordic mythology and are interested in knowing about the personal stories of people, stories of children like them, and natural history and archaeology of landscape. These papers contribute to the discussion of Dindler et al. (2010) and Dindler and Iversen (2009), in which the authors analyse how children relate to an installation that represent the geographical area in which they live and on how teenagers are not interested in history per se, but might be interested in stories about how it felt like to be a teenager in the past.

The final practice-oriented contribution of my study is represented by new concrete data about how technologies can contribute to the guided tours and museum learning practice in general. First of all, my contribution addresses both micro and macro level discourse, in this sense contributing to a comprehensive understanding of how technologies can facilitate daily learning and curatorial practices, and also of how technologies can affect the role of museums within society. From the micro level perspective I contribute with new insights about how a digital simulation could provide new opportunities in communicating historical knowledge from a diachronic perspective, uncovering meanings related to historical processes and opportunities on how mediated play could support a playful learning approach in the museum. This aspect is discussed in Paper 4 and builds on Rogoff (1995) and her understanding of learning as a process of appropriation or becoming related to the personal plane of sociocultural activity. The practical knowledge derived from these reflections include concrete examples about how the presence of a digital simulation altered the usual interaction taking place between the guides and the children, so that I saw the children addressing direct questions to the guides, hence engaging in a playful dialogue contextualised within the children's emergent role play. These insights are contribution to the study of interaction design proposing a novel approach, in which design practice is targeting an activity offered by the museum such as the guided tour, which according to recent studies like Best (2012) and Apostolellis and Bowman (2015) still remains to be addressed in depth. At the same time these insights complete the picture of how technologies can be used in the exhibition space discussing how guides and visitors can interact with each other, where most studies, like the already mentioned Apostolellis and Bowman (2015), Danielak et al. (2014), Ciolfi (2012), Iversen and Smith (2012), Muise and Wakkary (2010), focus on how visitors interact with other visitors through the interface. On a macro level perspective these insights have implications for how digital technologies can contribute to innovate the practice of guided tours and visitors' expectations on the practice. On the other hand, from the perspective of the practitioners, new knowledge are provided in Paper 1 about how the practice of organising new thematic and/or temporary exhibitions, which I call innovation enclosures, responds to the museum practitioners' needs to innovate their practice without endangering the quality of the main exhibition and of their reputation while facing the challenges of the on-going shift. This insight represents a contribution to museum studies like Lang et al. (2006) and Janes (2009), which focus on the organisational level of museum learning practice, hence investigating only to a limited extent how individually practitioners are dealing with the challenges of the shift. At the same time these insights about the practice of innovation enclosures contribute to the understanding of how museum practitioners are trying to innovate their practice while being under the pressure of the shift, where Hosker et al. (2014) are investigating the creation of innovative access to the museum archive through cross-sectorial cooperation and Lischke et al. (2014) contribute to the

understanding of how digital technologies can both empower users in creating their own virtual exhibitions and how these virtual exhibitions can be seen as sources of inspiration for museum practitioners. Similarly Iversen and Smith (2012) and Ciolfi (2012) suggest how social media could contribute to the innovation of curatorial practice, but do not look into how practitioners are engaging in innovation on their own. Paper 5 contributes to this discussion from the organisational, macro level discourse, reflecting on how the digitisation of the practice of innovation enclosures could empower museums in their relations to the external organisations, gathering evidence from their own exhibition experiments and the same time gaining control on possible cooperation with organisations providing the expertise that museums lack. I find that having individuated and analysed the practice of innovation enclosures in relation to the on-going shift, my study and the discussions conducted in Paper 1 and 5 help to contextualise the contributions of the works of Lischke et al. (2015), Hosker et al. (2014), Iversen and Smith (2012), and Ciolfi (2012) with respect to the challenges posed by the shift and how important could be the impact of my as well as of their solutions for the innovation of museum learning practice.

Having provided an overview of the knowledge contributions of my thesis, the following sections discuss the empirical data from which I have gained these knowledge contributions, in relation to the research questions and my publications. The following sections address the research questions, starting from the main one. The first section (7.1) discusses the data that answer to the main research question, about how design practice could approach the shift in the role of museums. Section 7.2 addresses the first sub-question and discusses the data that relate to the understanding of the sociocultural factors involved in museum learning practice and to the design of a new exhibit. Section 7.3 addresses the second and third sub-question, which deal respectively with the role of digital technologies within guided tours and learning of history inside the museum, and focuses on the empirical results gained from the evaluation of MicroCulture. Finally, section 7.4 proposes a conclusive reflection on the methodological implications of the study.

7.1 Design and the shift in the role of museums

This section critically discusses the empirical data in relation to the contributions presented in the included papers (Paper 1 and 5), in order to address the main research question, which aims at investigating how a design intervention could contribute to the shift in the role of museums. As already discussed in chapter 5 and in the introduction of this chapter my study analyses museum learning practice through an inclusive framework, building on an interdisciplinary perspective on the design of new digital exhibits. New findings are discussed such as: the sceptical attitude of museum practitioners towards digital technologies, the emergent practice of innovation enclosures, and how digital technologies could support museum learning practice, from the perspective of practitioners' and visitors' needs with respect to the on-going shift.

Many studies have been conducted and new technologies have been displayed in major and minor exhibitions, e.g. medien.welt in Vienna (Hornecker and Stifter 2006) and The Digital Natives exhibition in Aarhus Denmark (Iversen and Smith 2012). However, this thesis suggests that the digitisation of museum learning practice is still an on-going process, since the museum practitioners involved in this study look at digital technologies as a doubtful innovation trend and not as an educational tool that they can use. Through my literature review I found that the course of the shift is troublesome because it is affected by different and potentially conflicting needs,

which emerge from the micro and macro level of museum learning practice. From a macro level perspective (community plane) according to Dunmore (2006), governments have invested money in providing resources and high quality digital content has been developed for museums. However, on the micro level perspective (personal and interpersonal plane) the museum practitioners interviewed in this study do not have a clear vision on how to use that content in their practice. It has been argued that digital technologies will enable visitors to participate in curatorial practice (Lischke et al. 2014; Hosker et al. 2014) and will meet the needs of young visitors (e.g. Apostolellis and Bowman 2015; Dindler and Iversen 2009; Hornecker and Stifter 2006), who have integrated digital technologies in their everyday life (a remarkable case is represented by the penetration of smartphones and tablets in the past five to ten years). However, through my study I could see that a unifying understanding of how visitors would like to engage with digital exhibits is missing. According to the museologist from Ribe: "it is not even clear if the visitors would like to engage with digital technologies while visiting museums." During our final interview, she reported quotes from adult visitors who were relieved that they did not have to use their phone to enjoy the exhibition and said: "thank God I do not have to use my phone!" She interpreted the mentioned quote as revealing that the fact that people use digital technologies everyday does not necessarily imply that the same people would find desirable to use the same technologies in their museum experience. Moreover, she claimed that technologies could be even experienced as impediments by the visitors. For instance she reported the case of a tour of the historic buildings of Ribe, during which the visitors were supposed to use a GPS to find these buildings, but had troubles in making their GPS to work properly. Hence, based on her own experience, she says that she is not so sure if digital technologies can really make a difference for visitors and for which visitors.

Elaborating on the publications included in this thesis (Paper 1 and 5), I find that museum learning practice is a complex sociocultural practice, whose nature is interdisciplinary, in line with Roberts (2015) and Hosker et al. (2014). As mentioned in chapter 1 museum learning practice is defined in this thesis as the set of activities and interactions taking place during the encounter between the visitors and the museum. These activities include exhibition planning, workshops, seminars, guided tours, but also activities that lead towards the innovation of the mentioned activities, such as the practice of innovations enclosures that was investigated during this study (Paper 1), which is aimed at creating and testing ideas for new exhibitions. Building on the gained results this study suggests that in order to contribute to the shift in role of museums, design practice should strive to support one or more of these activities. For instance during the field study I have identified the emergent practice of innovation enclosures, the second finding discussed in this section. As argued in 5.1 and Paper 1, I interpret this practice as the attempt of museum practitioners to create a safe space for experiments or prototypes in the creation of new exhibitions without endangering the main exhibition, which is connected with the reputation of the museum. On a practical perspective, this means that in order to contribute to the on-going shift designers could address not only activities in which visitors engage on their own, but also the activities that museums offer to the visitors, including innovation practices like innovation enclosures. The practice of innovation enclosures embodies values from the different curatorial and administrative competences represented by different museum practitioners, in line with Ciolfi (2012) and Hosker et al. (2014), and the emergent pedagogical, technological and financial challenges that practitioners face when planning new exhibitions. As mentioned in the introduction to this chapter, this finding provides a contribution to the point made by Lyons et al. (2015) or Roberts et al. (2014), according to whom designers should address the activities visitors engage in while visiting museums. I suggest that if design practice could investigate the activities that are organised by the specific museum, like the practice of innovation enclosures, design researchers and designers will be in the position to deal with the interdisciplinary richness of museum learning practice, combining the different perspectives of museum practitioners and

their pedagogical and administrative needs, and that of visitors and their needs for engagement and learning, hence bridging micro and macro level discourses.

Finally concerning the role of digital technologies within museum learning practice and the on-going shift, I find that digital technologies have specific characteristics that could bring benefits to the practice of innovation enclosures. Specifically, digital technologies are flexible, as the same hardware can be reused and reformulated to convey different meanings, especially when off-the-shelf technologies are adopted (as mentioned in section 6.2). In this way, the specificity of a tangible digital exhibit created for a thematic or temporary exhibition, which is now embodied by the physical materials and their qualities, is transferred from the hardware to the software, a form of virtualisation (Butler 2011). In this way, as argued in Paper 5, museums could reuse the same hardware for different exhibits and within different thematic exhibitions. Hence the creation of new exhibits might demand a minor investment of resources, changing the understanding of such practices as discussed in Paper 5. Furthermore, it is argued in Paper 5 that the flexibility of digital technologies might also contribute to the adoption of user centred and participatory design approaches, actively involving visitors in improving existing applications or in developing new ones. According to the curator from Ribe, user centred approaches are being slowly adopted by local museums. As an example, he mentioned that a local school was invited to evaluate a new thematic exhibition in local museum, where he was previously employed. Simon (2012) argues that museum practitioners should reconsider how they understand curatorial practice and engage in a dialogue with the visitors, but does not discuss how technologies could support practitioners in innovating their daily work. In the terms of Simon, I see the practice of innovation enclosures as an example of participatory practice that the museums of Ribe and Coventry have implemented to involve the visitors in deciding upon how the main exhibition might be changed. Lischke et al. (2014) parallel exhibits installations enabling visitors to arrange their own exhibits online. Iversen and Smith (2012) instead explore how digital exhibits and social media can enable the visitors to engage in a dialogue with each other, by rearranging the media that are accessible through the exhibits. I see these studies as proposing a scenario in which the users can inspire museum practitioners in the way they engage with already created exhibitions.

Another issue I identified in my study is that the digitisation of museum learning practice can be seen as an additional threat to the autonomy of museums in handling their shift. The museologist from Ribe claimed that: "we hire graphic design companies and they have their own style. This is good, but not always. Some are more…" makes a strong vertical gesture with her hand from up to down to mean that some companies have a straight, geometrical style. She continues by saying: "which (the geometrical style) works fine for some things, but sometimes you have something in mind more (she waves her hand in the air with a gracious movement, to indicate a less rigid and more decorative style) for the exhibition, but you have to live with what they deliver." Similarly, the curator of Coventry took the initiative to actively involve local universities and marketing professionals (see Paper 1). This means that museums are borrowing lacking expertise involving external partners, which could support museums in exploring new exhibits as argued in Paper 5. This is the scenario discussed by Roberts (2015) and Mason (2015), in which external designers are cooperating with museums in the creation of new exhibits. This external support is needed because, as the museologist points out: "we are in a learning process, now I am starting to understand what I need," but when she and her colleagues hire an external company, it becomes difficult for them to make the desired pedagogical statement. In this sense, there is a risk that digital technologies might even disempower museums more with respect to the shift and to the content developed for new exhibitions. This aspect gives a more precise meaning to the question of the curator of Ribe when he asked if in future it would be possible for him to modify the

simulation of MicroCulture[35]. In so doing, he showed an interest in regaining control over the creation of new content for his museum, as discussed in chapter 5. These insights about how practitioners perceive the intervention of external designers in the design of new exhibits bring new knowledge to the area studied by the mentioned Roberts (2015) and Mason (2015). These two studies analyse the process of creating new exhibits from the perspective of designers and discuss the perspective of museum practitioners only to a limited extent. More specifically Roberts is concerned with the factors affecting the role of designers in the design of new exhibits and the perspective of design practitioners is mainly discussed in relation to how the factor of the "client experience and attitude" towards the design of new exhibits (Roberts 2015, p. 384) might affect how designers can concretely contribute to the process. Mason instead discusses how prototyping practice can support the interdisciplinary cooperation between museum practitioners and designers. Prototyping activity is seen as specifically supporting knowledge transfer and interdisciplinary cooperation. With respect to the studies of Roberts and Mason, these insights about how practitioners perceive the on-going shift, can support in understanding how practitioners relate to the changes affecting their own role and the future of their competences. Hence the insights provided by my studies can help understanding the difficulties of museum practitioners who are challenged in having to integrate new knowledge in design practice and digital technologies, which they do not have. These insights also provide new knowledge into the discussion conducted by Ciolfi (2012), in relation to the need of an inclusive perspective that could approach museum learning practice from the perspective of the practitioners and the visitors communities. Ciolfi's work focuses on how design practice could contribute to make the work of heritage sites more participatory and open to visitors' active involvement. My study is in this sense confirming the need of the inclusive perspective discussed by Ciolfi (2012). At the same time my study brings new insights about how practitioners relate with the new digitisation and participatory trends imposed by the shift.

7.2 Sociocultural factors and museum learning practice

This section discusses the empirical data that I have analysed to address the first sub-question and identify the sociocultural factors involved in museum learning practice and in the design of digital exhibits.

I found coherence between the empirical insights gained from my study and my literature review (Roberts 2015; Dysthe et al. 2012; Pierroux 2010), so that museum learning practice emerges as a complex sociocultural activity defined by values, traditions, interactions, and materials. All these aspects are in a complex relationship with each other and can be continually redefined by emergent practices, such as the dialogic interactions taking place inside a specific museum. Emergent and traditional practices are in a complex interplay as they can influence, constrain, and affect each other, as discussed in the introduction of the chapter. Following Rogoff's (1990) studies on sociocultural activity, museum learning practice is affected by sociocultural factors, which can be grouped into three main categories such as:

1. The sociocultural context;
2. The physical space;

[35] This question from the curator of Ribe is discussed further in section 7.2.3.

3. The individual participants.

Rogoff (1995) places the individual participants as the first main category in her approach; however, in this thesis, I alter the order of the elements constituting sociocultural activity, placing the sociocultural context in first place. As I discuss further in 7.4 this change is done to support a critical identification of key users of the new exhibit.

This study contributes to the discovery of the sociocultural factors involved in museum learning practice, hence adding new knowledge to the field of interaction design, especially to the studies of Apostolellis and Bowman (2015), who investigate the sociocultural factors affecting visitors' learning inside the museum, focusing on the visitors' personal perspective. In my study I bring new insights about the sociocultural factors affecting museum learning practice from the perspective of the museum context and providing a sociocultural theoretical grounding through the work of Rogoff (1995, 1990). At the same time new knowledge is provided to the studies of Roberts (2015), who investigates the factors that affect the role of the designer in creating new exhibits for museums. However, where Roberts focuses her discussion on factors that relate to how museum practitioners might lead the structure of the different projects, in my study I look into factors that affect museum learning practice and its on-going shift, in order to highlight what designers should know or take into account, in order to concretely support museum learning practice, meeting the need of the practitioners and the visitors. This knowledge has also methodological implications, which are discussed in 7.4, in relation to the insights of Iversen and Smith (2012) and Ciolfi's inclusive perspective (2012), as I introduce new aspects that are key to the visitors' learning experience and curatorial practice. A contribution can finally be found in relation to the understanding of museum learning practice from a pedagogical, experiential, and curatorial perspective, where studies like Crowley and Jacobs (2002) focus on how children might learn inside the museum. Simon (2010) and Dysthe et al. (2012) instead focus on how museums are becoming more open to the active involvement of visitors in discussing and exploring the meaning of the exhibition. Falk (2013) on the other hand discusses the different motivations of visitors to come to the museum and, similarly to Apostolellis and Bowman (2015), indirectly points out which sociocultural factors might affect how visitors relate to their museum visit and to their learning. My study in this respect discusses which factors come into play, in defining how museum learning practice takes place, from the perspective of both the visitors and the practitioners, and which factors should be addressed by design practice specifically targeting the digitisation of museum learning practice.

The following discussion proposes a critical overview of what interaction designers and researchers should know and take into account about the sociocultural factors involved in museum learning practice.

7.2.1 Sociocultural context

Analysing the empirical data I collected through interviews with museum practitioners (see also chapter 5 and Paper 1) I found that guided tours are a central but little studied activity, taking place inside museums, which offers opportunities to understand and take into account the needs of practitioners and young visitors. Moreover, guided tours are affected by sociocultural values and traditions (Dysthe et al. 2012; Pierroux 2010), which are not directly defined by the individual practitioner, but emerge from the sociocultural and political framework within which each museum operates.

A certain consistency emerged in the way museum learning practice is implemented by the two museums involved in this study. In line with Rogoff (1995, 1990), I find that museum learning practice is built on cultural traditions that are passed from the previous generations of museum practitioners. These traditions represent key factors to take into account when designing for the museums, as these can explain how guided tours and curatorial practice are implemented in specific museums. Moreover, the practitioners from both museums have referred to traditions as affecting their daily practice. In this respect I found similar traditions in the way the two museums organise their main exhibitions: first of all both museums display antiquities and tangible exhibits following a diachronic structure, from the oldest to the most recent. In this way visitors' tours take the shape of a walk through time, as it is discussed in Paper 1. Another tradition that I have identified through my study is that the practitioners from both museums interpret their practice as a form of storytelling (Marchetti 2011a). This aspect was especially emphasised in the case of guided tours, where the guides see themselves as engaging in a form of interactive storytelling with young visitors (Marchetti 2011a). The factor of traditions in museum learning practice is central to defining the professional mind-set that museum practitioners have gained through their training, their working environment, and their relations with external institutions, including the educational system. Therefore, in line with Rogoff's three planes (Rogoff 1995) and the three circles model (Löwgren and Stolterman 2007), traditions are seen as sociocultural factors that belong to the community plane and the context circle of the design situation, which includes the global network of the museum (Law and Callon 1995). I find that in order to contribute to museum learning practice and the on-going shift from the perspective of visitors and practitioners, design practice should explore explicitly how different solutions relate to such traditions, for instance if these solutions can be integrated or challenge existing traditions. At the same time, it should be investigated how the individual practitioners relate to them, if they see positive values or emergent issues to fix. For instance MicroCulture is trying to challenge the typical social interaction emerging between guides and children, in which guides talk and children listen to them but do not talk most of the time. This interaction can be seen as a traditional form of learning, in which the museum practitioners pass knowledge to the visitors, in line with Dysthe et al. (2012). Interestingly, through my study both guides and children identified an issue in this kind of social interaction, hence in my design I am challenging a traditional form of interaction, taking into account the needs of the different groups of participants.

On the other hand, the digitisation of museum learning practice represents a complex on-going technological and organisational shift that is affecting the role of museums and what is expected from their practice. In this respect another central factor to consider in design practice is the practitioners' perception of the role of museums as organisations, as it might have implications on how museum practitioners see their role within society in disseminating knowledge, which activities they offer to the visitors, the goals of such activities, and consequently which technologies or other materials they would choose. For instance the practitioners from the two museums involved in this study have repeatedly mentioned that their role is to support learning. This means that a technology that mainly target visitors' engagement might not be purchased. Practical factors related to the shift in the role of museums should also be considered, including practical financial challenges like recent cuts in the budget, which might hinder practitioners from buying expensive technologies. For instance, challenges can be identified in the fact that local museums can rely upon fewer financial resources than larger institutions, so that technological options are restricted to affordable hardware, in line with McCaw et al. (2014). For instance, the curator from Ribe stated that the use of digital technologies in the museums might require high investments but might also elicit a shallow interaction, in which children would simply "push all the buttons without learning anything." In this way he expressed concerns about the potentially elevated costs of digital technologies and the actual learning value of the same technologies. Moreover, following Hooper-Greenhill et al. (2000) political sociocultural factors like the degree of authority and relations to external organisations are as important as financial challenges. For

instance none of the two curators participating in my study changed the main exhibitions, because these fit well with the expectations of local schools. With this said, I do not mean that designers are not entitled to propose highly innovative technologies, but based on my study I find that museum practitioners are constrained in their freedom of innovating their practice (Paper 1) and that they wish to better understand how new exhibits might contribute to their own goals and their daily practice, with respect to philosophical principles and practical matters.

7.2.2 Physical environment

Digital exhibits should fit within and contribute to current exhibitions in terms of physical configuration and meaning. Different setups were considered for the design of MicroCulture; however, talking to practitioners, it became clear that the choice of the material and physical configuration of the new exhibit had to take into account factors related to the physical exhibition rooms, such as: limitations of space, lightning, safety norms, and laws that the museum has to observe in its practice. Moreover, as pointed out by Fienup-Riordan (1999), the spatial layout of an exhibition is participating in conveying meaning; hence it contributes to the visitors' learning process. In this respect, the design process should address how the new exhibit will contribute to the physical layout of the exhibition in relation to dissemination of historical knowledge, cognitively and aesthetically.

For instance, during an interview, the museologist from Ribe recalled a case in which a group of students wanted to install a big wooden structure outside the museum, but had to reformulate their concept because laws prevent the museum from occupying the area in front of its entrance. In the case of MicroCulture, the original concept involved a large video installation to be placed on the floor (see Paper 5). However, such an installation would not fit within the small exhibition space, so a more practical solution was conceptualised, taking a look at the tangible exhibits available inside the museum. Inspiration came from a diorama showing the original settlement of Ribe (Fig. 31), as discussed in Paper 5. The guides referred to the diorama during guided tours to discuss the foundation of Ribe and the children participating in the study appreciated it, as according to them it looked like "a toy." In this sense, MicroCulture was conceptualised as an interactive version of the diorama displayed in the museum.

These insights contribute to the understanding of the importance of contextualising the design of new digital exhibits within museum physical environment, which was already emphasised by Fienup-Riordan (1999). Hence complementing Roberts (2015), these insights contribute to the understanding of the interdisciplinary aspects of the design of new exhibits including architectural, legal, and pedagogical matters regarding the museum space as a context for learning history. Similar concerns are also found in McCaw et al. (2014) where the exhibition is located in a former private residence and Ciolfi (2012) and her reflections on how exhibits could enrich the visitors' perception of the life of heritage sites. In this respect my study provides new knowledge about how the museum physical environment could be involved in affecting designers' decisions as well as practitioners' choice of new technologies.

Generalising, designers should take advantage and inspiration from existing exhibitions and their physical environment, to consider how new technologies can blend with existing elements and with the use of physical materials inside the museum.

7.2.3 Individual Participants

Figure 31. Diorama showing the original settlement of Ribe (Paper 5).

The professional identity of museum practitioners, and more specifically of the guides, pertains to the museum environment and the practices taking place there, including traditions, norms and the issues emerging from the shift. But it also involves museum practitioners' education, individual values and needs, which in turn have implications on the integration of technologies within museum learning practice. On the other hand, visitors represent a more diversified group, having different interests regarding their own life as well as museum related matters. This aspect has been investigated already in different studies like Falk (2013) who deals with visitors' motivation, Apostolellis and Bowman (2015) who discuss sociocultural processes affecting the visitors' learning process and Dindler and Iversen (2009), who leverage their design intervention on how teenagers relate to historical exhibitions. I find that the sociocultural background of the individual participants is a central aspect to address in the design process. This aspect can be detailed further into factors like: demography (age, gender, eventually ethnicity), professional identity and values, motivations for participating in museum practice, specific needs and wishes. The inclusive perspective constructed for this study attempts, therefore, to grasp some key factors attaining the sociocultural background of the individuals involved in guided tours, practitioners, and children visiting museums.

When addressing museum practitioners, the typical traits that distinguish these practitioners from other professionals is their diversified background in the humanities, as already mentioned in the previous section and chapter 5, and their commitment in disseminating knowledge. Based on my data I found that the humanities background of practitioners and their doubtful attitude towards technologies could be interconnected and crucial in understanding museum learning practice, its shift, and the professional values of museum practitioners (see Paper 1). Similar aspects are considered central to participatory and user centred design, where users are involved in the evaluation of new technologies as experts in their field (Yliriksu and Buur 2007; Druin 2002). Simon (2010) and Roberts (2015), who deal more specifically with the museum context, also refer to the importance of actively involving users in the design of new exhibits. The mentioned

insights about how the professional background of museum practitioners affects their perception of technologies, can contribute to understand more clearly the difficulties of practitioners in dealing with design practice and the role of the designers in the making of new exhibits.

In chapter 5 and 6 I argue that a need of empowerment is common for the museum practitioners and the visitors, where the practitioners have expressed the desire to gain control on the on-going shift as it is affected by external institutions who might have authority on the museums, the visitors instead have expressed the desire to have more freedom of action during guided tours. This point was well expressed in the final interview with the museologist from Ribe, who said that before adopting a technology she has to know: "what's in it for me?" I interpret this statement as suggesting that the digitisation of museum learning practice should address her needs and not only those of the visitors. This particular aspect about practitioners' perception of technologies represent an addition to the perspectives provided by Ciolfi (2012), who highlights that the mission of heritage sites is "to offer information and knowledge to the visitors" (Ciolfi 2012, p. 71) and advocates for designers to consider the different competences of museum practitioners (see section 2.2.2 p. 55 of this thesis). In this respect my work is bringing new concrete examples about how museum practitioners perceive digital technologies and how is their perception of technologies affected by their professional competences. Moreover, in discussing the design requirements I gained for MicroCulture during my field study and my participatory workshops (Paper 1 and 3), I analyse the practitioners' needs regarding how technologies could support their daily practice inside the museum. In this sense I continue on the path of Ciolfi, providing concrete examples of what designers could consider in their design intervention. These same insights are also complementing the designer's centred perspective provided by Roberts (2015) and Mason (2015), wherein both studies look more specifically into what benefits users centred design practices and prototyping can bring to the creation of new exhibits. My knowledge contributions bring new insights to support a more comprehensive understanding of the digitisation of museum learning practice, combining the perspective of practitioners and visitors. On the other hand these insights of the practitioners' perception of technologies contribute to the understanding of the sociocultural factors that can affect visitors' learning process in the museum, which were investigated by Apostolellis and Bowman (2015) from the perspective of the young visitors.

During the final interviews the practitioners from Ribe were critical about current research, because according to them it is not offering support to their practice. They have the impression that studies in interaction design provide interesting insights about technologies, but do not often consider practitioners' needs. Museum studies are instead seen as proposing new philosophical insights on curatorial practice, but without offering concrete solutions or perspectives that could help practitioners in improving their practice. The works of few authors like Falk (2013) are exception to this, as according to both the museologist and curator of Ribe, Falk provides practitioners with concepts to understand visitors' motivations. The curator said: "this knowledge (Falk's analysis on visitors' motivation) is helpful in improving our communication strategies. She (the museologist) has even made a poster (on Falk's analysis of visitors' motivation) and hung it on the wall of our office." I interpret this quote as a sign that the museum practitioners from Ribe wish to find in research concrete suggestions or analytical perspectives, like Falk's analysis of visitors' motivation, which could suggest them new directions to improve their own practice. In this respect my study is adding new knowledge to the studies of Ciolfi (2012), Roberts (2015) and Mason (2015), contributing with concrete knowledge about the needs and values of the practitioners. However, this knowledge has not to be taken as an objective truth about the on-going shift or the status of current research, but rather as uncovering the personal perspectives of the practitioners involved, which can explain why in some cases a technical solution might be found engaging for the visitors, but nevertheless it is not acquired by museums. For instance, the

museologist from Ribe was clear that: "we cannot adopt mobile solutions requiring wireless connection to the Internet," regardless of the advantages mobile solutions might provide in terms of engagement and learning, simply because: "installing a wifi connection for the whole museum is too expensive for our budget, we cannot afford it!" It is in this sense practical issues, like costs, that emerge as important to consider when designing for museums, in agreement with McCaw et al. (2014). In conclusion, the practitioners from Ribe see digital technologies as something imposed from the outside, bringing unfamiliar values and requiring new skills that museum practitioners do not have. The museologist claims that: "I have been in an intensive learning process in the past three years, now I am starting to be able to say what I need." Moreover, she says: "our goal would be to include technologies within the spectrum of our other tools, but we are not there yet."

As already discussed in chapter 5 and 6 and in the included Paper 3, issues can be found also on the visitors' side. For instance, my study shows that the children face constraints when they lack "something to do" (as discussed in chapter 5) and express different individual needs regarding play and museum experience (Paper 3); contributing further to the work of Apostolellis and Bowman (2015) in understanding the sociocultural affecting how young visitors can learn inside the museum.

In conclusion, the adoption of an inclusive framework has allowed me to gather rich insights about guided tours intended as one of the practices that takes place during the encounter between visitors and practitioners and their respective values, interests, and goals. The study of guided tours represents a privileged opportunity for designers to enrich museum practice from an inclusive perspective and to contextualise digital technologies within the sociocultural framework of traditions, constraints, and pedagogical principles of museum learning practice.

7.3 Guided tour practice, play and learning of history

This section discusses the empirical data related to the second and third sub-questions, dealing respectively with how can digital technologies contribute to guided tours and to learning of history inside the museum. The discussion is grounded on the findings from the final evaluation of MicroCulture at the museum of Ribe during three guided tours held with three different groups of children within the target group. The following two paragraphs discuss empirical findings from the evaluations, which are also discussed in Paper 4 included in this thesis and also in Marchetti and Petersson (2013) from more specific perspectives, dealing with playful learning culture and participatory design practice. These findings provide new knowledge about how digital technologies could contribute to the guided tours, addressing the richness of this activity, while it is not specifically addressed in current interaction design studies. For instance Apostolellis and Bowman (2015), McCaw et al. (2014) and Ciolfi (2012) partly touch the subject of guided tours, while most interaction design studies address activities that visitors engage in on their own. As mentioned already in the introduction of the chapter, Lyons et al. (2015) address the spontaneous activity of visitors' tinkering in science museums, theorising that designers should support the activities in which visitors engage during their visit, fostering learning and curiosity. Similarly Muratsu et al. (2014) aim at facilitating the activity of scientific inquiry in science museums. My study contributes to the knowledge provided by the mentioned studies, as it addresses the guided tours, which is a specific activity in which visitors engage, but that it is also offered by the museum. In this way my study is contributing to bridge between the different perspectives held by interaction design studies, which focus on visitors and technologies, and the

few museum studies about the guided tours, which focus on the guided tour and the perspective of museums as cultural organisations.

Findings from my study also bring new knowledge in relation to how digital technologies can foster learning of history eliciting deeper understandings of historical processes, specifically in relation to the values of practitioners and visitors from a micro level perspective. As unfolded below, my study contributes to understand how digital technologies can enrich learning of history when most studies in interaction design address preferably science museums (Apostolellis and Bowman 2015; Lyons et al 2015; Muratsu et al. 2014; Danielak et al. 2014). On the other hand those addressing history and heritage, like Ciolfi (2012) or Iversen and Smith (2012), are not concerned with visitors' learning but rather with fostering engagement and participatory curatorial practice.

The scenario proposed by this thesis is that digital technologies could be meaningfully introduced within museum learning practice, transforming guided tours from a lecture into a playful apprenticeship in thinking. As discussed in Paper 2, play is seen as a resource for social interaction and learning, creating grounding for goal directed activities for the guides and the children, in line with Rogoff (1990), supporting mediated interaction (Wertsch 1991) and abstract thinking (Simon 1996; Vygotsky 1978). Analysis of video material gathered during the final evaluation of MicroCulture enabled me to identify interactions that lead towards learning, as I will detail in the following three sections (7.3.1, 7.3.2, and 7.3.3) and more briefly in Paper 4. These interactions are defined in this thesis as: the emergence of a dialogue between the children and the guides and the emergence of role-play between the children and the guides. These two types of interaction have implications for the practice of guided tours and for learning of history, with regards to the personal and the interpersonal planes of the interactions taking place inside the museums (micro level) and also for the cultural role of museum within the community plane of practice (macro level).

The following sub-sections discuss how these two types of interaction affected guided tour practice (7.3.1) and learning of history (7.3.2) during testing, based on the analysis of how the children and the guides interacted with each other and with MicroCulture. Section 7.3.3 instead provides reflections on the limitations of MicroCulture identified during the evaluation.

7.3.1 Guided tour practice as playful apprenticeship

This sub-section discusses the empirical data found during the final evaluation, in relation to how digital technologies could turn guided tour practice into a playful apprenticeship, contributing to the understanding of the role of digital exhibits within museum learning practice.

As already mentioned in chapter 5 and Paper 2, the limited communication from the children to the guides was identified as a central issue. In this respect the main result gained during the evaluation of MicroCulture was that the children were enabled to use more actively the social guidance offered by the guides, so that their interaction could converge more towards a dialogue than lecturing, differently from what was observed during the field study. This aspect is discussed further in Paper 4 and in the following section (7.3.2). As the children approached MicroCulture, they asked questions to the guides in order to be able to play. This is considered a positive result because in normal conditions children were not observed asking unsolicited questions to the guides. When playing MicroCulture some individuals addressed their questions directly to the guides, while others asked questions to their mates or more generally to the group. The guides

took the opportunity to assist the children either addressing them directly or simply looking towards the direction of the children asking the question. By asking questions, the children communicated to the guides their interests, doubts, and understandings in a more explicit and intentional way than in normal conditions, as detailed in Paper 1 and 2 and in Marchetti (2011a). Moreover, the presence of an interactive game-simulation elicited in the children a desire to play, where play is intended as a transaction about social interaction and norms (Petersson 2006; Sutton-Smith 1997), enabling them to decide how to socially interact with each other and the guides.

Not all the children were observed directly addressing the guides; a few in each of the three groups testing MicroCulture were silent most of the time and simply explored the simulation on their own. This behaviour could be connected with the need of a quiet individual experience, as it was observed during the field study and the design process (see Paper 3). However, as the children were playing alone, they at times listened to what the other children and the guides were talking about. In the gathered video material, these children appeared as listening, as they lifted and turned their head towards the group, in this respect, it is possible to say that they participated in the on-going interaction in their own way. As a result the formal interaction observed during the beginning of the guided tour was gradually replaced by a playful dialogue, in which each individual participated in different ways. In this respect, I find that the presence of a playful but open digital exhibit enabled the children to find their own individual way to experience the exhibit, hence contributing to turning the guided tours from a lecture into a playful apprenticeship as discussed in Paper 4.

On the other hand, the guides were able to segment the emergent discussion providing knowledge and connecting and comparing the different statements of the children, in line with Ritchhart (2007) and Pierroux (2010). This emergent dynamics is considered evidence that MicroCulture adequately meets the requirements of making visitors more active in their learning through use of social guidance and the needs of the guides about having more interaction and better ways to assess what the children are interested into. It is in this way that the prototype worked as a mediational mean (Wertsch 1991), creating conditions for dialogue and playful learning.

Analysing the video recordings of the final evaluation, I identified 4 stages through which the emergent dialogue between the children and the guides evolved, as the children got acquainted with MicroCulture and were granted more freedom by the guides. These stages are defined based on typical utterances expressed by the children (Table 6), as discussed further in details in Paper 4 (p. 139-141) and in the following sub-sections.

Table 6. Results of the analysis regarding stages of play and categorisation of emergent interaction.

Stages	Group	Focus	Typical utterances
Technical	All Groups	Features and technical functionality of MicroCulture	- Can I use more tangibles at the same time? - How can I do…? - What is this?

Collaborative	All groups	Development of the settlement and cooperation	- What should we do…? - Who has a bridge? (or other tangible) - How can we get the people to go to the market?
Role-play	All groups	Theatrical enactment and attachment to their own "island"	- We need more streets in our land - Our people need a wall!
Competitive	1st and partially 3rd group	Teasing and strategic use of tangibles to hinder each other	- J. you are trapped!

Technical stage

The children started with what I call the *Technical stage*, during which, they explored the features of the simulation, the technical functionalities, and how to use the tangibles. Through this stage, the children engaged in playful investigations of the artefacts available questioning how they could be used, in line with Petersson (2006) and Bundy (1997).

For instance, a girl asked the guide: "is it possible to remove them?" She was talking about trees or swamps represented in the simulation. The guide said that she could not remove them directly, but that she had to use the tangibles and then the girl tried on her own with a street tangible, while a boy looked at the response of the characters and commented: "ahhhh it was cool! Cool! They come again (the characters)." A frequent question was: "how many tangibles can I use?" Or "can I use more tangibles at a time?" These questions seemed aimed at finding out if the game play was turn-based. In this way, the children were exploring with the guides how the tangibles affected the characters and how they could play with MicroCulture.

The technical stage took about 5 minutes in each of the three observations at Ribe museum.

Collaborative play

Afterwards, the children moved towards the second stage, which I call *Collaborative play*, in which they focused their attention on the simulation of the settlement and its dynamics. During this stage, a playful mediated dialogue emerged about the historical dynamics of urban development, in which the available artefacts worked as mediational means inseparable from the social interaction taking place (Wertsch 1991).

The prototype supported both social and solitary forms of designerly play, which also emerged during the design process. From this second stage, the guides were able to engage into a mediated discussion about urban development and the historical meaning behind the simulation. The children reflected aloud on how to connect different areas, as shown in Paper 4, their thinking was mirroring practical considerations regarding the logic behind the infrastructures' placement, rediscovering how infrastructures were used in the past and are still used nowadays. For instance, the guides and the children discussed together how to enable the characters to reach the market

place. A boy asked: "should there be another market place there?" And the guide answered: "there should be a street and the street should be connected to a bridge!" The boy then asked to his mates looking around: "where is a bridge?" A girl passed a bridge tangible to the boy, who placed it in the area where the finger of the guide was pointing. The girl then added: "there should also be this!" And passed a street-tangible to the boy.

The interaction emerging during this stage reminds of what happened during the participatory design workshops discussed in chapter 6 and Paper 3. The children explored how they could alter the landscape as well as the behaviour of the characters through the tangibles, engaging in designerly ways of knowing and in conceptual thinking (Cross 2006; Vygotsky 1978). Hence the simulative/role-play approach adopted in the design of the prototype elicited a playful experience, in which the children cooperated with each other and the guides in developing their settlements. Moreover, this form of mediated play enabled them to reflect as kings about how the placement of infrastructure can change the landscape and the behaviour of its inhabitants.

Role-play

This form of collaborative play faded gradually into the third stage, which I call *Role-play*, characterised by the players' focus on self. The passage to the third stage is signalled by utterances revealing group-awareness and an attachment to the land. For instance, the use of the words "we" and "our," in relation to a market place or settlement, became more frequent and the children displayed an individual urgency in having a specific action performed. For instance, a boy from the first group said: "we need a street here! We need a street here!" Or a girl from the second group said: "we need more streets for our settlement."

When reaching this stage, the children should be able to imagine how it felt to be human in that particular historical period. In fact, this stage unfolded as fantasy play, defined by Sutton-Smith (1997) as a form of play in which children hallucinate as if the situation depicted in their play was real. This form of play lead towards abstract thinking, as discussed by Vygotsky (1978), as the children were projected into an imaginary world and reflected about which actions they should perform and their effects. Moreover, this form of play enabled the children to give voice to their needs of identification into the stories they hear about the past; a similar principle is discussed in literature with respect to how teenagers perceive historical exhibitions (Dindler and Iversen 2009). In this way the form of mediated play facilitated by MicroCulture fostered in the children reflections on the historical content of the simulation.

At the same time, Role-play is the social counterpart of the simulative approach followed for the design of MicroCulture: the use of simulations as a learning tool (Simon 2006) is combined with mediated social interaction occurring in apprenticeship in thinking (Rogoff 1990). In this way, the children played the role of kings with each other in their physical world and within the virtual world of the simulation, bridged through the mediational mean represented by the tangible interface of MicroCulture. Through this form of play, the children enacted the meaning embedded in the simulation and with the help of the guides they were abled to see the implications of their actions within the historical meaning of the simulation.

Individual differences were detected in the way the children were playing during the evaluation, in line with findings from the design process and studies about visitors (Apostolellis and Bowman 2015; Falk 2013). Some children communicated intensely with each other and the guides, others explored possible configurations for their territory without much talking. In this sense, MicroCulture proved to be open enough to support social as well as individual players, a challenge when designing digital exhibits as discussed in Paper 4.

Competitive play

The three stages considered so far were identified in all groups, but only individuals in the first and the third groups (and only partially) moved towards the final stage, which I call *Competitive play*. This stage is characterised by competition and teasing through verbal and non-verbal language. This form of play is, in this sense, a development of the Role-play stage towards a more theatrical mood and exploration of what is allowed in terms of social norms (Sutton-Smith 1997). This stage is marked by expressions of teasing, for instance in the third group a girl was placing a bridge, but the bridge was oriented towards the water and not the river banks, so her friend (another girl) said: "oh no! They can't (Laughing)! Look! They (The peasants) are trying!" The girls made an annoyed face and then her friend continued: "it is a strange road … or a strange bridge! It should have been the other way!" In the end, the two girls laughed looking at the peasants coming to the bridge and going back and forth not being able to cross the river.

However, it was in the first group that competitive play emerged in a more distinctive way, when a girl placed a series of circular defensive walls to prevent the characters coming from an island, a boy was playing with, to cross the river and reach a market place located on another island (Fig. 32-33) (see Paper 4 and Marchetti and Petersson 2013). After having placed her walls the girl said: "caught! J. You are caught!" The guide participated saying: "is he caught? Oh poor you! (to the boy) What are you going to do?"

The boy said: "nooo!" And in response the boy placed a series of bridges around the rampart in order to create an escape path for his peasants.

This form of interaction intertwines abstract and designerly thinking, in line with Vygotsky (1978) and Cross (2006), through the enactment of a military attack. Through this forms of play, the children rediscovered the strategic values of infrastructures in warfare, exploring in line with Bundy (1997) what the tangibles of MicroCulture could do in the simulation and how they could be used in social play. Their interactions with the defensive ramparts were reminiscent of the real-life mediated interactions that took place between competing kings or landlords from the Viking and Middle Ages who used infrastructures to attack each other or defend their camps (Graham-Campbell and Valor 2007; Schmidt 1994). This competitive form of play was also observed during the redesign of the low-fidelity prototypes. It emerges in my analysis as a mature stage of play, indicating that a playful state of mind has been reached by the players, but also that the players are at ease and confident with the pieces and rules of the simulation. On the other hand, in the final test of MicroCulture, when reaching the 3rd and 4th stages, the children were more in control than in any other moment during the guided tour. Through their role-play, they created a space for themselves where they could reformulate their own mediated interaction and guided tours social norms as a narrative in their game (Sutton-Smith 1997; Rogoff 1990). At this stage, the learners reach a creative appropriation on the activity at hand and responsibility transfer is performed, leading towards learning and knowledge appropriation (Rogoff 1990); more details are provided in the next section (7.3.2) and in Paper 4.

7.3.2 Learning of history, role-play, and identification

Coherently to the results from the field study, during the final evaluations the children engaged in a form of fantasy role-play (Sutton-Smith 1997; Vygotsky 1978), identifying themselves with the situation depicted in the simulation as if it was real and enacting the role of Viking landlords. This process of identification emerged through the progression of the different stages of play to become explicit during the role-play stage. The guides actively participated in this process and

Figure 32. Competitive play: a boy is placing bridges to help the peasants from his island to reach the other river bank (Paper 5).

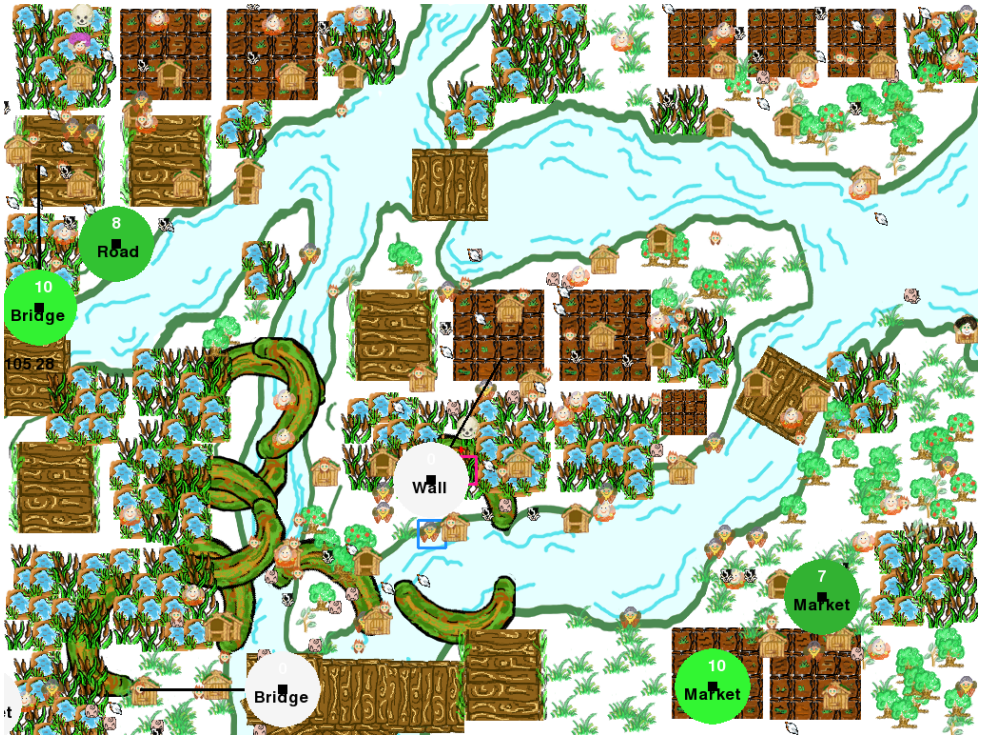

Figure 33. Screenshot of competitive play (Marchetti and Petersson Brooks 2013).

Figure 34. Female guide introducing the exhibit.

Figure 35. Male guide commenting on the children play.

had a significant impact on how the children performed their role and their freedom of exploring such roles. Similarly to the children, the guides showed different attitudes towards their facilitation role eliciting different forms of interaction, role-play, and knowledge transfer. As discussed in Paper 4, the guide interacting with the first group, the only one displaying a distinctive form of competitive play, assisted the children in the first stage of play, but as the children familiarised with the simulation and entered the second stage, she left them play by themselves, intervening when the children asked questions (Fig. 34). The other guide, who interacted with the other two groups, was instead more active in giving continuous guidance to the children (Fig. 35). He supervised the children by asking them questions such as: "how can the little men get to the market place without a bridge?" Or "don't we have too many market places? What do we need now?" Meaning that more streets should be added.

Although the guides were more prone towards responsibility transfer when dealing with an interactive simulation targeted at children's play, they displayed different attitudes towards responsibility transfer, affecting interaction, play, and learning. According to Rogoff (1990), children who are facilitated by adults are prone to grant responsibility and thus tend to master their new skills at earlier stages than children who are facilitated by adults who are prone to provide constant guidance. This means that through early responsibility transfer, children become proficient and skilled in a shorter time, exploring their own eventual possibilities or risks. Similarly, the first group, the only one really engaging in the fourth stage of competitive play, was left independent from the second stage. As a result, this first group was able to explore more freely how to play, but also understand the social norms involved in their play. The guides' different attitudes towards facilitation can be interpreted as emergent strategies in readjusting their role as authorities and teachers (Rogoff 1990), with respect to the new technology and play (Sutton-Smith 1997).

Recalling the notion of dialogue (Rogoff 1990) introduced in chapter 5 as a requirement for the design of MicroCulture, each guide achieved different balances in handling the asymmetries in their dialogue with the children. The female guide delegated her power to the children and communicated her intention verbally and physically, staying on one side (Fig. 34). Instead, the male guide shared his power with the children, but remained close to the centre of the action for the entire time, sometimes moving from one side to the back (Fig. 35). As a result, the guides also participated in role-play and different roles and different relationships were explored between the children and the guides across the groups. In the first group, led by the female guide, the children were in control and acted as kings or landlords, individually or in groups, who could decide to cooperate or attack each other, as it happened towards the end of the game. The female guide played the role of the noble advisor, who gave suggestions to the kings, supporting them in fulfilling their plans. She played a subservient role, which empowered the children in a more significant way, when reaching the stage of Collaborative and Competitive play. In the case of the second and third groups, the constant participation of the male guide in children's play have determined a different balance, in which children self-expression was in part constrained to the point that the children remained dependent on his help. The children cooperated with each other as if they were noblemen, acting under the command of a common king, the male guide.

The mentioned progression of stages can be analysed as a progression in the asymmetries normally involved in learning (Rogoff 1990). At the same time, these stages can also be analysed as stages of a learning process, intended as a process of becoming (Rogoff 1995), in which the children learn becoming characters within the situation and active learners within the guided tour. Furthermore, the presence of a playful exhibit, designed specifically for the children to enjoy, made the guides more prone to grant independence to the children than in normal conditions. The guides tended to leave the children play with each other while helping them in grasping the

connections between the simulation and its historical content, (this aspect is further discussed in Paper 2 and 4). In this sense, mediated play affected social interaction during the guided tours adding a theatrical nuance to the improvisational aspect of guided tours practice identified by Best (2012). At the same time, the segmentation activity usually performed by the guides according to literature (Pierroux 2010; Ritchhart 2007), such as directing the attention of the children to specific artefacts, addressing questions, commenting, and reconnecting children's statements, acquired new meaning within the framework of fantasy role-play. These findings contribute to the understanding of how playful, digital exhibits can contribute to museum experience, in relation to the creation of relevant interactive representations of the historical content, adding to Lyons et al. (2015) who focus on scientific knowledge. Moreover, these findings also contribute to the understanding of the emergence of individualised forms of play supported by digital technologies during guided tours, a topic partially touched in literature (Apostolellis and Bowman 2015).

Moreover, I see this aspect of role-play and identification (of both guides and children) in learning practice as an instance of Vygotsky's theory of play and learning (Vygotsky 1978) that contributes to understand how exactly play and imagination elicit abstract thinking in a social context. Open questions emerge in relation to the (inter)actions expressed by the children and the guides, the role of the prototype and of the different attitudes of the guides in relation to responsibility transfer. In this respect I see this link between digital simulations, role-play, and learning as opening up for the exploration of new opportunities to approach playful learning in museums, through mediated educational activities.

7.3.3 Limitations identified during the evaluation of MicroCulture

MicroCulture was successful in many aspects, but it still presents limitations that became evident during the evaluations, regarding how the guides engaged with the children and the exhibit, and the lack of support for playful play. It was expected for instance that the simulation would have encouraged the guides in discussing parallels between present and past, as during a normal tour, specifically in relation to citizens' mobility and connections, dissemination of market places, archaeology of landscape, and the use of infrastructures in warfare. However, the guides limited themselves to show links between the features of the simulation to the past, answering to children's questions and observing carefully their play. Through such parallels, the children could have reflected more critically about how urban settlements changed through time and about the socio-political meaning embodied by the streets, bridges and commercial centres they see every day in their town. In this sense, playful/designerly ways of learning could be elicited in the form of children's appropriation of the exhibit and of the historical meaning embodied in it (Rogoff 1995, p. 139), and a richer awareness of settlement culture could have been fostered through comparative and critical thinking, in line with Pierroux (2010) and Dysthe et al. (2012). In this respect, the introduction of new mediating means has created novel conditions for guided tour practice, but it might have unintentionally led to restricting the focus of the participants on what was literally represented in the simulation, hence interfering with usual practices. The only exception was represented by the female guide who provided me with data to represent the demographic distribution of the population of Ribe, as discussed in chapter 6 and might have had a personal motivation to discuss this matter with the children.

Furthermore, the guides did not really play with the children, but observed their play and participated in their conversations as facilitators. This behaviour can be interpreted as an

implication of the responsibility transfer performed by the guides (Wertsch 1991; Rogoff 1990), but also as a lack of experience or of will of playing during tours. At the same time, it could also be that MicroCulture did not adequately give a chance for the guides to engage in play. These results could suggest that the guides should have been even more involved in the design process, to investigate how they would have liked to interact with the children and at the same time, feel comfortable with their role of facilitators with the new technology.

Other limitations were found in relation to support for playful play, defined as a highly creative form of play, in which players create new rules and play situations for others (Sutton-Smith 1997). Playful play emerged in several occasions during the design process, as discussed in chapter 5 and Paper 3. Data from the evaluations suggest that, although the high-fidelity prototype enriched children's experience with its tangible interface, real time feedback, animations, visual and sound effects, however, it did not allow for playful play as the low-fidelity prototype did. My interpretation of these findings is that this happened because the alteration of a digital simulation (for example: the introduction of new features or rules) is less accessible than the alteration of low-fidelity prototypes, since it requires programming skills and that the users interrupt their play in order to change the code. As a result, the children were able to explore the high-fidelity simulation as they wanted, but they were not able to engage in playful play. This lack has implications for personal and interpersonal interaction as intended in Rogoff's planes (1995), designerly play, and abstract thinking (Cross 2006; Vygotsky 1978), and demands for further studies. The children who engaged in playful play with the low-fidelity prototype, during the participatory workshops, contributed to the other children's role-competitive play. This elicited a complex ecology of play, in which the different forms of play could coexist and support each other, enriching the children's play and social interaction. Although technically highly challenging, the future creation of a friendly user-programmable exhibit will enable children to contribute from their perspective during tours in line with the digital solutions proposed by Lischke et al. (2014) and their parallel exhibits, and the use of social media proposed by Iversen and Smith (2012) and Ciolfi (2012). At the same time this new exhibit should allow curators to gain control on the content represented, a requirement so far not met by MicroCulture as discussed in Paper 3, 4 and 5.

In conclusion, the design process and the prototype have produced relevant results in relation to the main goals of the study. At a more general level, the limitations identified during the final evaluation could be related to the need of adjustments in the use of the proposed inclusive framework. Further studies are needed regarding the role of the guides as facilitators and players within guided tour practice.

7.4 Methodological implications

The use of the inclusive framework proposed in this thesis has affected the methodological decisions and research contributions of this study. It required looking into different groups of users, visitors, and practitioners, and to establish an interdisciplinary grounding. As already mentioned in chapter 3 and in the introduction to this chapter, this framework builds mainly on the studies of Rogoff (1990, 1995), Vygotsky (1978) and Wertsch (1991), in combination with the three circles model (Löwgren and Stolterman 2004). Moreover, the formulation of this framework is interdisciplinary as it represents a way to bridge different perspectives from the different areas of: the organisational (Roberts 2015; Hosker et al. 2014; Janes 2009) and the cultural perspective of museum learning practice (Lischke et al. 2014; Simon 2010), studies about

the guided tours (Best 2012; Dysthe et al. 2012; Pierroux 2010), and interaction design studies concerning playful interaction (Apostolellis and Bowman 2015; Lyons et al. 2015; Muise and Wakkary 2010) and methodological perspectives (McCaw et al. 2014; Iversen and Smith 2012; Ciolfi 2012). The combination of theoretical perspectives related to different research areas can be seen as a distinctive trait of my work, when generally research work focuses on perspectives related to one main area.

A drawback of this approach is that the involvement of different sources and users groups requires deciding to which extent literature belonging to the different fields should be read and how much should the various users be involved in field work and in the design process. This implies that something was necessarily omitted in terms of theoretical insights from literature and data gathered through the involvement of specific groups. Other possibilities could have been considered such as conducting parallel participatory design workshops with the guides or simply involving the guides in the same workshops conducted with the children. However, such possibilities were not pursued as emerging results suggested a greater need for the children to gain control on the practice, even according to the guides. As a result, it was not explored if and how guides could see themselves actively playing with the children, as discussed in section 7.3.3. More insights could also have been gathered in relation to how history could have been represented diachronically in interactive simulations, but it emerged as a difficult topic to discuss and articulate for the practitioners involved in the study, hence it was decided to deal with this topic involving them in commenting how historical meaning was embodied in the prototypes.

Adopting an inclusive framework is not in itself a new idea, since similar inclusive approaches have been previously adopted in other studies combining a sociocultural perspective with design-oriented research such as Petersson (2006) and Arvola (2004). Similarly the already mentioned Ciolfi (2012) talks about the need to adopt an inclusive perspective in designing new exhibits for heritage sites, so to take into adequate consideration the richness of the community of practitioners and visitors. However, the novelty here is that this inclusive framework is aimed at bridging micro and macro level discourses, which are not explicitly discussed in literature, with the goal of investigating how digital technologies can contribute to museum learning practice, seen from a pedagogical and organisational perspective.

Analysing the work of Petersson and Arvola, a link can be identified between inclusion and adoption of sociocultural perspectives in academic studies. For instance, the study conducted by Rogoff (1995) about girls scouts cookie sales did not only focus on the girls, who are the main participants, but she also looked into how the girls cooperated with their mothers and with the other adults involved and how they all related to norms and traditions involved in the practice. As a result, rich insights were gathered in relation to how the activity is contextualised within the surrounding community. Similarly, studies like Petersson (2006) involved care takers in studying how ludic engagement could facilitate learning for children with special needs in order to overcome the difficulties end-users might experience in expressing their needs. In this way, richer insights were gathered combining the input from end-users with that of care takers, who were able to interpret the end-users' expressions of uneasiness or enjoyment for the researchers (Petersson 2006). A similar strategy emerged also in the study of Ciolfi (2012), when she discusses how the educators were able to make more engaging for the users the experience of newly created exhibits. The same approach was followed in this thesis, for instance, identification and role-play emerged as a need and/or a spontaneous way in which children engage with stories from the past, combining results from observations of the children and interviews with the guides. The key need for user empowerment in museum experience and in the shift in the role of museums emerged also while combining insights gathered from the children and from the practitioners. In this respect, an inclusive sociocultural perspective applied to interaction design studies can enable the researchers to identify concerns or needs that are shared across different

categories of users, hence providing a solid grounding for design decisions. However, I see my work as bringing new contributions to the mentioned studies, as I see the involvement of the different key participants in museum learning practice as a pre-condition to bridge the micro and macro level discourses and not as my final goal. Hence I see my studies as contributing to the theoretical discourse about museum learning practice: first in acknowledging and explicating the fragmentation between micro and macro level discourses and second in bridging the two discourses towards a more comprehensive understanding of museum learning practice and its digitisation.

Notably, the mentioned studies are all grounded on multiple empirical cases, from which differentiated data and in-depth reflections are gathered and elaborated into theoretical contributions. For instance, Rogoff (1990), Ciolfi (2012), Petersson (2006), and Arvola (2004) conducted empirical studies involving multiple contexts and groups of users. I adopted this option for the field study, leveraging on the availability of the two museums. But because of concerns about the already broad focus of the study, I decided to narrow down the design process to the development of one single prototype for one specific context. This decision allowed me to concentrate the available time and resources on the development and evaluation of one prototype. However, a case-based study would have contributed to a more critical discussion of the inclusive framework and possibly provided richer insights about how the new learning scenario would have affected different contexts.

These decisions are reflected by the structure of the whole thesis as well as of this discussion chapter (Fig. 3, section 1.4 p. 31), as the focus of the discussion is broader when investigating the sociocultural factors involved in museum practice, but it becomes narrower when discussing the design intervention. In the end, the focus is reopened when reflecting on the final evaluation of MicroCulture, considered as an exemplar case of how MicroCulture could affect learning in museums, in line with Zimmerman et al. (2007). Objections might be raised on the validity of the gathered data, since the prototype was designed and tested for Ribe, while the museum in Coventry was included only in the field study. In this sense, multiple cases could have permitted for a triangulation of data evaluating the technologies with respect to the different users involved, as according to Firestone (1993) multiple qualitative case studies are best suited to understand a situation and people's understanding of that situation. This option will be explored in future work and in this regard other historical museums could be involved.

The inclusive framework proposed in this thesis has methodological implications, in relation to how the design process could address the shift and museum learning practice in general. The main implication I derive from my approach, is that the first step in designing for museum learning practice should be to look into the sociocultural context, which is the specific museum(s) where the new digital exhibit will be used. In this way, the designer has to deal with the sociocultural factors (meanings, values, and constraints) influencing the context of practice as well as the adoption and use of digital technologies, bridging micro and macro level perspectives. This reflection might seem trivial, however, I find that it becomes meaningful in the design of museum digital exhibits, where researchers tend to prioritise the needs of the visitors, seen as end-users, while the museum practitioners are typically not involved in significant ways. As a result, it becomes difficult for them to see the advantages of adopting a new exhibit in their practice.

After having investigated the sociocultural context, designers should identify the specific activities that take place in the context, which goals these activities are supposed to fulfil, and how they contribute to the surrounding society. From here designers could pick one or more activities as unit of analysis, an approach that is recommended by Rogoff (1995) and Vygotsky (1978) and that is starting to emerge also in current interaction design literature (Lyons et al. 2015; Muratsu et al. 2014). This has implications in relation to how the design intervention is contextualised,

with respect to how the new digital exhibit is expected to contribute to the context. The selected activity will represent an exemplar of other activities occurring in the same context, in terms of meaning, goals, norms, and traditions. In the same way, the design artefact created for this activity will represent a design exemplar embodying meanings and research findings to be communicated to the users and the design/research community, in line with Zimmerman et al. (2007).

After having gathered knowledge about the sociocultural context and having selected one main activity (or more) as unit of analysis, the participants have to be investigated in relation to their own sociocultural worlds and to how they contribute to the activity. Therefore, the designer must address such questions as: Who are the participants? In which relation are they to the context? To which other contexts do they belong? How do they contribute to the practice? What are their roles and goals? Why do they participate in the activity and what are they supposed to gain? In this respect I find that combining Rogoff's three planes of sociocultural activity (1995) and the three circles model by Löwgren and Stolterman (2004) can be used to critically determine the key participants and their role in the activity at hand.

As already discussed in chapter 4, in the specific case of guided tours discussed in this thesis, I have identified guides and primary school children as the key participants as they are directly involved (personal-interpersonal plane) in making the guided tour happen. Curators and museologists are located at the periphery of guided tour practice, as they indirectly interact with children through the frame they set for the guided tours and the new exhibit. However, as these practitioners are in charge of deciding what is worth learning and which technologies to purchase, it is rather important that they are also involved in the design process, although not to the same extent as the guides and the visitors. Finally, schools, ministries of education, and culture are placed in the context circle or the community plane, as they affect norms, museum relation to tradition and innovation, material and financial resources allocated to museums, hence, indirectly affecting guided tours. Figure 2 in chapter 1 provides an overview of all these participants, their roles and placement with respect to Rogoff's three planes. In this respect, the designer has to formulate new scenarios taking into account the data gathered about the sociocultural context, the selected practice taking place, and the factors affecting such practice, and also the insights provided by key participants. In this sense, a new scenario for the practice will help to understand how newly designed technologies acquire specific meaning in relation to the gathered data about practice and context.

A main difficulty in the application of this approach was to decide how to involve the different groups of users in the process, with respect to their role within guided tours, select from the rich insights they provided, and establish priorities for the design intervention. In this respect, there is a risk of penalising groups of users, who will not be able to handle the new technologies despite the designer's effort in involving all key participants. A possible strategy for the designer adopting this framework is to treat this difficulty as one of the design requirements, as discussed with respect to the three circles model (Löwgren and Stolterman 2004).

Finally, the inclusive framework discussed in this thesis is formulated taking into account the needs of local historical-archaeological museums and specifically addresses the needs of young visitors. More studies are required to evaluate how this framework can scale to larger museums, which involve a larger number of participants (practitioners and visitors). In this case, more effort will be required in identifying and involving key participants and selecting from the insights they will provide.

8. Conclusions

This thesis discusses the empirical study and knowledge contributions of a design-oriented research (Fallman 2003) about the digitisation of museum learning practice. Five papers have been included in this thesis, to provide the reader with an in-depth discussion about the empirical data and the contributions gained in the study. Building on literature review and empirical data this thesis suggests that the digitisation of museum learning practice is a troublesome process, taking place within an on-going shift, in which the role of museum learning practice is being questioned with respect to what it can offer to society (Dysthe et al. 2012; Lang et al. 2006).

Through my literature review I have identified a fragmentation in two parallel discourses: a micro level discourse dealing with how museum learning practice occurs with respect to the individuals involved, and a macro level discourse dealing with the organisational and community perspective of museum learning practice. Interaction design research focusing on digital exhibits (Apostolellis and Bowman 2015; Hosker et al. 2014; Muise and Wakkary 2010; Dindler and Iversen 2009; Hornecker 2008) has provided contributions mainly to the micro level discourse, analysing how visitors interact with specific digital exhibits. Museum studies (Roberts 2015; Simon 2012; Janes 2009; Lang et al. 2006) have instead contributed mostly to the macro level discourse, analysing the organisational challenges that museum practitioners are facing through the shift. Only a few studies combine the two discourses, analysing the role of museums within society starting from what happens among visitors and educators when engaged in museum learning practice (Ciolfi 2012; Dysthe et al. 2012; Hooper-Greenhill et al. 2004, 2000). In this thesis the emergence of these parallel discourses is seen as generating partial views, unable to thoroughly address the needs of museum practitioners, with regards to the digitisation of museum learning practice. As a result, I found that museum practitioners are sceptical about how digital exhibits could contribute to museum learning practice (Paper 1 and 5). Starting from the mentioned perspectives, an empirical study has been conducted and several papers have been published to investigate the following research questions:

> How is it possible to conduct a design intervention that could contribute to the shift in the role of museums?
>
> - Which sociocultural factors are involved in the design of technologies targeted at museum learning practice and young visitors?
> - How can digital technologies contribute to the practice of guided tours (as a concrete example of museum learning practice)
> - How can a digital exhibit enrich learning of history inside the museum?

These research questions are used as a structure for the different sections of each chapter and are addressed in the five papers included in the thesis.

The first question is the main one, while the following three are to be regarded as sub-problems of the main question. Through my empirical work I found that museum practitioners see themselves as challenged by an on-going shift in the role of museums. Although they might be engaged in investigating new opportunities to disseminate historical knowledge, the practitioners participating in this study perceive this shift as determined by external influences, which are posing conflicting requirements to museums in order to improve the quality and organisational effectiveness of museum learning practice. The digitisation of museum learning practice is part of

this on-going shift and it is perceived by museum practitioners as a troublesome trend, since it is not evident to them how it might affect museum learning practice, as discussed in Paper 1. In addition the digitisation of museum learning practice is challenged by museum practitioners' limited technical expertise and limited budgets. In this respect I suggest that designing for museum learning practice has become a complex practice and design practice could better support museum learning practice and the shift, by bridging the fragmentation between the above mentioned micro and macro level discourses. A direct effect of this fragmentation can be found for instance in the fact that interaction design studies have prioritised the needs of the visitors over those of the practitioners. As a result interaction design studies typically do not address the needs of museum practitioners or existing learning practices. Interesting attempts have been made in addressing curatorial practice (Hosker et al. 2014; Iversen and Smith 2012) or spontaneous activities of the visitors (Lyons et al. 2015; Muratsu et al. 2014). In this way I found in my study that the involved museum practitioners find it hard to grasp which advantages could digital technologies bring to their daily practice and how could they deal with the financial and practical challenges. Therefore, I propose a new inclusive framework to bridge micro and macro level discourses, in order to gain more comprehensive understanding of how digital technologies could be integrated within museum learning practice. I suggest that the design process should start by addressing the sociocultural context and all the participants involved in museum learning practice, in line with Ciolfi (2012). Moreover, in order to bridge micro and macro level discourses, the design process should build on insights from the different fields related to the study of museums and digital exhibits. The inclusive framework I propose in my thesis combines the three analytical planes of sociocultural activity (Rogoff 1995) with the three circles model (Löwgren and Stolterman 2004), in order to secure a more comprehensive perspective on what museum learning practice is and how it is changing, with respect to all the participants involved and the museum's surrounding society. I also suggest that designers could choose as a unit of analysis one or more of the activities that are offered by museums, in line with Rogoff (1995), in order to better contextualise the design intervention. In this case I have decided to focus on the guided tour, which emerges from literature as a widespread but little studied practice (Best 2012). At the same time I have decided to consider also how my design outcome could contribute to the emergent practice of innovation enclosures (Paper 1 and 5), which represents the practitioners' attempt to create a safe space for practicing innovation. In this way I could investigate more concretely museum learning practice, looking into how that specific activity takes place and how it could be enriched by the integration of digital technologies. These aspects are specifically addressed by the second and third sub-questions, which deal with how technologies could enrich the guided tours and learning of history inside the museum.

In order to address the first sub-question, I have analysed guided tours as a typical activity offered by museums and I have identified a series of sociocultural factors that can affect how museum learning practice takes place and the acquisition of new technologies. These factors can be seen as aspects to consider, in order to support museum learning practice and to take into account the needs of both the practitioners and the visitors.

These factors can be grouped into three main categories: the sociocultural context, the physical environment, and the participants. In line with Rogoff (1990) the sociocultural context embodies specific factors that affect how museum learning practice is taking place, such as: cultural traditions that are passed from one generation to the next, the perception of museum practitioners of the role of museum within society, financial issues and costs, and the degree of authority and relations to external organisations, as discussed in chapter 7. These factors determine the set of practices or activities that specific museums offer to the visitors and the goals of these activities. The practitioners involved in my study mentioned financial matters and a lack of vision for the role of technologies in learning, as the main reasons why local museums were cautious with the use of digital technologies. For instance the museologist from Ribe said it

is not possible for them to adopt mobile solutions that require wireless Internet connection, because it would be too expensive for the museum to get a wireless connection in first place.

Since digital exhibits will be displayed in the exhibition rooms, close to the other artefacts, I find that it is important to consider how the new digital exhibit will fit within the physical environment of specific museums. Practical constraints might affect the acquisition of new exhibits within the specific museum, such as limitations of the available space, lightning, eventual security rules and laws. Moreover, as discussed by Fienup-Riordan (1999) the layout of the exhibition contributes to communicating the cultural meaning of the artefacts. As a result, particular attention should be dedicated to the placement of the artefacts and of eventual digital exhibits, avoiding the risk of including exhibits that do not fit aesthetically or that might send misleading messages to the visitors.

Museum learning practice is defined in this thesis as the set of activities and practices, through which visitors and practitioners meet each other; this means that both visitors and practitioners participate in museum learning practice and that these represent two groups of individuals with distinctive needs. In this respect I identified specific sociocultural factors related to the participants, which should be considered in the design process such as: demography (age, gender, eventually ethnicity), professional identity and values, motivations. All of these factors participate in defining the participants' sociocultural background. In line with literature (Woollard 2006), museum practitioners' emerged in my study as characterised by a varied background in humanities and their commitment to disseminate historical knowledge. Since my study focuses on the guided tours, I paid particular attention to the guides and how they relate to their practice. In this way I found that the guides' background could be even more diverse than that of curators, especially in Denmark where the guides from Ribe are retired professionals, who went through a specific training. However, in the two museums that were involved in my study, guided tours are seen by the guides as a form of storytelling, aimed at eliciting in the young visitors interest for their historical heritage. Moreover, in both museums guided tours are recommended to the children to understand the meaning embodied in the exhibitions, as the children alone might not be able to identify the displayed artefacts (Paper 1). Visitors are the participant group that appears most diversified and in my thesis I focus specifically on primary school children around 9-10 years of age. During my study I found that these children do not go to the museum by their own choice, but are rather taken to museums by adults. Typically children experience guided tours while visiting a museum with their class and while there they interact as if they were attending a lecture: they are silent most of the time, not asking unsolicited questions and raising their hands when asked a question by the guides. Through task-based interviews the children participating in this study said that they perceive guided tours as providing limited possibilities for engagement. On the other hand, the children appeared interested in the stories of individuals from the past, especially of their age, and also about matters related to Nordic mythology and archaeology of landscape (Paper 3 and 4). Interestingly both the children and the practitioners emerged from my analysis as dealing with an issue of empowerment, as practitioners wish to regain control on the on-going shift and children feel the need for more opportunities to do something on their own while being at the museum.

Taking into account the insights gathered on the sociocultural factors affecting museum learning practice, I addressed the second sub-question investigating how a digital exhibit could enrich the practice of guided tours. In this respect I discuss in Paper 2 and 4 that play mediated by digital technologies could be a valuable resource in enriching the social interaction emerging between children and guides. According to Rogoff (1990) children learn when engaging in shared goal-oriented activities together with more expert adults, who support them when meeting their "zone of proximal development" (Vygostky 1978, p. 87; Rogoff 1990, p. 14; Wertsch 1991, p. 28), defined as the boundary between the skills and knowledge that the children already have and those that they have still to acquire. Moreover, in line with the studies of Vygotsky (1978) on play

and learning and of Wertsch (1991) about mediated action, mediated play is seen as a social interaction in which players are transported into a different world in which they start reflecting on the implications of their actions in their play. In this way, according to Vygotsky (1978), mediated play facilitates children in acquiring skills in conceptual thinking. Similar forms of play emerged spontaneously during my participatory workshops, as the children after having setting up their paper tangibles started playing as if they were rival kings in the process of developing their kingdom and engaging in war with each other. Taking these insights into account I propose that digital exhibits could embody shared goal-oriented activities for the children and the guides, in the forms of playful tasks within a game or simulation about historical knowledge. In this way the children could start practising conceptual thinking through their play about the historical knowledge represented by the exhibit, hence creating conditions for twisting guided tours from a lecture into a playful learning experience. On the other hand, play is seen as a form of negotiation, in which players freely explore social norms (Sutton-Smith 1997), in this way if the guides and the children could engage in play early during their guided tour, they could readjust their typical interaction and converge towards a dialogue (Paper 2). Summarising my findings I propose that digital technologies could contribute to enrich the guided tours, providing goal-oriented activities for children and guides to engage in, at the same time eliciting in the children forms of conceptual thinking about the learning content and finally support the children and the guides to explore more dialogic forms of social interaction.

In investigating the last sub-question I combined the studies of Carr (2001) about history and Simon (1996) about simulations, I propose an approach in which technologies can contribute to learning of history inside the museum, enabling children to imagine how it could have felt to live in a different time. According to Carr (2001) historical facts can be defined as the result of social processes, in which individuals participate as social beings under the influence of social forces, which might generate unexpected or unwished outcomes. During my study I found that exhibits displayed in museums relate to history from a synchronic perspective, attempting to shorten the time distance between the present and the past. On the other hand museums generally employ verbal narratives to communicate historical knowledge from a diachronic perspective. According to the practitioners who participated in my study, this approach is used because it meets the requirements of the school system and also because it is not easy to see how artefacts could support communication of history as a social process. However, I find that this approach of communicating the diachronic perspective of history mainly through verbal narratives might reduce historical processes into a sequence of names and dates, hiding their real complexity. Interestingly, inspirations to explore alternative approaches to communicate about historical processes can be found in the strategies adopted by the guides and in the tendency towards role play expressed by children. During observations of guided tours I could notice that the guides refer to the displayed artefacts to tell lively stories about the past, such as how it felt to participate in a Viking raid, traveling through the North Sea on a small boat with no roof and in stormy weather. On the other hand during the design process the children spontaneously engaged in forms of role play, in which they acted as if they were collaborating or competing kings. Therefore, I focused my design process on exploring how I could transpose historical processes into a digital exhibit and I focused on urban development in the Viking Age as a case, because this topic is central to the dissemination activity of the Viking Museum in Ribe. Taking inspiration from Simon (1996) I tried to create a digital simulation that could represent key aspects of urban development in the Viking Age, to enable the children to imagine how it could have felt to live at a different time. Summarising, and to address my third sub-question, I propose that digital exhibits could contribute to enrich learning of history inside the museums, enabling children to experience how it felt to participate in historical processes, seen as social processes, through forms of mediated role play. In this way the children should be enabled to reflect more about historical processes, reconstructing through their role play the dynamics involved and the

commitment that was required of kings to make a village turn into a city, eventually exploring parallels between the present and the past.

The result of the transposition of historical processes into a digital simulation is embodied in a tabletop, digital exhibit called MicroCulture, designed around urban development in the Viking Age. The design of MicroCulture is seen as a design exemplar in line with Stolterman et al. (2007), illustrating how the knowledge gained from addressing the research questions could be embodied in the creation of a new digital exhibit. MicroCulture can be defined as an interactive simulation in the terms of Simon (1996), reproducing key aspects of the process of the development of the Viking city of Ribe (Jensen 1991). The design process was conducted in cooperation with the Transport Museum in Coventry and The Viking Museum in Ribe. A group of 25 primary school children (9 to 10 years old) was involved in a participatory design process (Druin 2002), supported by qualitative ethnographic methods such as (visual) ethnography, situated interviews (Pink 2007), and interaction analysis (Jordan and Henderson 1995). In line with Zimmerman et al. (2007), MicroCulture provided a design exemplar of how digital technologies can be integrated within museum learning practice supporting different users (young visitors, guides, and curators) when sociocultural factors related to the context of the specific museum, the physical environment and the individuals involved, are taken into account. The empirical study builds on the studies on sociocultural activities conducted by Rogoff (1995, 1990). According to Rogoff, human activity emerges from the interplay between the individuals involved and their physical environment, which includes artefacts, norms, routines, and traditions that were established at a societal/community level (Rogoff 1995). Children participating in sociocultural activities learn new skills and knowledge, becoming prepared to contribute to their community (Rogoff 1990). Focusing on guided tours addressed to young visitors, MicroCulture is intended to work as a mediational mean (Wertch 1991), supporting a reconfiguration of the social interaction emerging between the children and the guides from a lecture into a dialogue (Paper 4). The simulative approach taken in the design of MicroCulture, elicited rich forms of mediated role-play, through which the children experienced what it meant to be Viking kings or noblemen involved in urban development, and the guides explored different forms of facilitation playing different roles according to their attitude towards responsibility transfer (Rogoff 1990). MicroCulture is designed with off-the-shelf technologies and can be easily reconfigured to represent other historical processes. In this way, MicroCulture could support the emergent practice of innovation enclosures, which provides a space for safe explorations through the creation of minor thematic exhibitions. Therefore, the design of MicroCulture addresses this thesis' research questions by providing an example of how digital exhibits could contribute to the on-going shift enriching existing practices.

This thesis provides two kinds of contributions, comprising three theory-oriented contributions and three practice-oriented contributions. The theory-oriented contributions comprehend an inclusive framework to address the digitisation of museum learning practice, which builds on Rogoff's three analytical planes (1995) and the three circles model (Löwgren and Stolterman 2004). Starting from Rogoff's studies on sociocultural activity (1995) and learning in informal contexts (1990), the design situation is analysed so that the three circles model is integrated with Rogoff's three planes of sociocultural activity (personal, interpersonal, and community), at the same time opening up towards inclusion of administrative and financial matters, which are not taken into account in existing frameworks like that proposed by Zimmerman et al. (2007). This framework was formulated at the end of the field study and provided a useful point of departure for the design process. Moreover, the second theory-oriented contribution is represented by theoretical insights about the fragmentation between micro and macro level discourses, which is not explicitly discussed in literature but it is reconstructed in a few studies (Dysthe et al. 2012; Hooper-Greenhill et al. 2004). New theoretical insights are provided about museum learning practice seen as a complex sociocultural practice. Through the three analytical planes of Rogoff

(1995) a more comprehensive perspective is discussed about how museum learning practice is affected by its surrounding society as well as by the individual participants, and the related sociocultural factors. The third and final theory-oriented contribution includes insights about the role of digital technologies, seen as boundary objects that could contribute to enrich the communication between the museum and the visitors from a micro level perspective, and also the museum with the surrounding society from a macro level perspective.

The practice-oriented contributions comprise the already mentioned creation of MicroCulture, which embodies my understanding of how digital technologies could contribute to museum learning practice, taking into account the on-going shift and the needs of both visitors and practitioners. In designing an evaluating MicroCulture, I also gained new insights about how the practice of guided tour takes place, which represents the second practice-oriented contribution. In this respect I have analysed how guides and children interact with each other inside the museum and through the displayed artefacts (Paper 2). I have also investigated the strategies that the guides employ to gain attention from the children and to engage in a dialogue with them, which include asking children to identify specific artefacts in the exhibition and looking at their gaze to find our which objects capture their interest (Marchetti 2011a). At the same time I have gained concrete insights about how the children perceive historical museums and guided tours, highlighting the existence of a communication issue in the social interaction unfolding between the children and the guides. Finally for the third contribution taking into account these insights, I have then contributed to the understanding of how digital technologies could contribute to the guided tours, proposing a playful learning scenario supported by forms of mediated play. Building on the studies of Rogoff (1990), Vygotsky (1991) and Wertsch (1991) I discuss mediated play as a resource for learning and for the emergence of dialogue between the children and the guides.

In conclusion, the creation and use of this inclusive framework has enabled me to address my research questions, bridging micro and macro level discourses and taking into account the needs of key participants as well as the sociocultural factors affecting their practice. This framework has methodological implications, suggesting that in order to contribute to the digitisation of museum learning practice, the design process should start by addressing the sociocultural context and the activities that take place, in order to critically identify key users, differently from what is generally recommended by sociocultural and design studies, which tend to address the participants in first place (Apostolellis and Bowman 2015; Rogoff 1995). My inclusive framework, however, has been formulated from the perspective of local historical/archaeological museums, young visitors and in particular primary school children, this means that further applications of the inclusive framework are needed to investigate how it can be generalised to larger museums with different foci.

References

Abascal, J. and Nicolle, C. 2005. "Moving towards inclusive design guidelines for socially and ethically aware HCI." *Interacting with Computers*, 17 (5), Elsevier Science Inc., New York, USA pp. 484-505

Allen, L. B. And Crowley, K. 2014. "Challenging Beliefs, Practices and Content: How Museum Educators Change." *Science Education*, 98 (1), pp. 84–105

Apostolellis, P. and Bowman, D. A. 2015. "Small Group Learning with Games in Museums: Effects of Interactivity as Mediated by Cultural Differences." *Proceedings of IDC '15*, June 21 - 25, 2015, Medford, MA, USA, pp. 160-169

Arvola, M. 2004. "Shades of Use: The Dynamics of Interaction Design for Sociable Use." Linköping Studies in Science and Technology, Linköping, Sweden

Barraclough, G. 1955. "History in a changing world." Blackwell, Oxford

Bateson, G. 1972. "Steps to an ecology of mind." Jason Aronson Inc., Northvale New Jersey, London, Usa

Best, K. 2012. "Making museums tours better: understanding what a guided tour really is and what a guided tour really does." *Museum Management and Curatorship*, 27 (2), Routledge, London, UK, pp. 35-52

Bloch, M. 1990. "The Royal Touch Monarchy and Miracles in France and England." First edition in French 1924, Dorset Press

Bourdieu, P. 1986. "The forms of Capital." *Handbook of Theory of Research for the Sociology of Education*. Richardson, J. E. Ed., Greenwood Press, pp. 241-258

Bruid-Zeidman, L. and Schmitt-Pantel, P. 1989. "La religion greque. Dans le cités à l'époque classique." Armand Colin, Paris, France

Bundy, A. 1997. "Play and Playfulness: What to Look for." *Play in Occupational Therapy for Children*, Parham L.D. and Fazio L.S., Mosby, St. Louis Eds., USA, pp. 52-66

Butler, M. 2011. "Android Changing the Mobile Landscape." *Pervasive Computing*, 10 (1), IEEE, January-March 2011, pp. 4-7

Bødker, S. and Buur, J. 2002. "The Design Collaboratorium—a Place for Usability Design." *ACM Transactions on Computer-Human Interaction*, 9 (2), June 2002, ACM, New York, USA pp. 152–169

Carr, E. H. 2001. "What is History?" Palgrave, Houndmills, Basingstoke, Hampshire.

Casey, D. and Murphy, K. 2009. "Issues in using methodological triangulation in research." *Nurse Researcher*, 16 (4), RCN Publishing, pp. 40-55

Cash, R., Wikler, D., Saxena, A. and Capron, A. 2009. "Casebook on Ethical Issues in International Health Research." World Health Organisation, http://www.who.int/rpc/publications/ethics_casebook/en/ (last access: 10 September 2015)

Christians, C. G. 2005. "Ethics and politics in qualitative research." *The Sage Handbook of Qualitative Research*, Denzin, N. K. and Lincoln, Y., Eds. Sage, Los Angeles, New York, New Delhi, London.

Ciolfi, L. 2012. "Social Traces. Participation and the creation of shared heritage. In Heritage and Social Media." *Understanding heritage in a participatory culture*, Giaccardi, E. Ed., Routledge, pp. 69-86

Cross, N. 2006. "Designerly Ways of Knowing." 1st edition 1942, Springer-Verlag London Limited, UK

Crowley, K. and Jacobs, M. 2002. "Building Islands of Expertise in Everyday Family Activity". *Learning Conversations in Museums*, G. Leinhardt, K. Crowley, K. Knutson, and Mahwah, NJ. Eds., Lawrence Erlbaum Associates, pp. 1-23

Danielak, B. A., Mechtley, A., Berland, M., Lyons, L, and Eydt, R. 2014. "MakeScape Lite: A Prototype Learning Environment for Making and Design." *Proceedings of IDC'14,* June 17, 2014, Aarhus, Denmark, pp. 229-232

Department of Children and Youth Affairs. 2012. "Guidance for developing ethical research projects involving children." Minister for Children and Youth Affairs, Dublin, Ireland. www.dcya.gov.ie/documents/Publications/Ethics_Guidance.pdf (last access: 11 September 2015).

De Vane, B. and Squire, K. D. 2012 "Activity Theory in the Learning Technologies." *Theoretical Foundations of Learning Environments*, Jonassen D. and Land S. Eds., Routledge, New York and London, pp. 242-267

Dewey, J. 1916. "Democracy and Education." MacMillan, New York

Dewey, J. 1938. "Experience and Education." Kappa Delta Pi, Indianapolis, Indiana

Dindler, C. and Iversen, O.S. 2009. "Motivation in the museum-mediating between everyday engagement and cultural heritage". *NORDES'09: Engaging Artefacts*, Nordic Design Research, Oslo, Norway

Dindler, C., Iversen, O.S., Smith, R. and Veerasawmy, R. 2010. "Participatory design at the museum: inquiring into children everyday engagement in cultural heritage". *Proceedings of OZCHI 2010, the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction*, 22-26 November 2010, Brisbane, Australia

Druin, A. 1999. "Cooperative Inquiry: Developing New Technologies for Children with Children." *Proceedings of CHI'99*, May 15-20 1999, Pittsburgh, USA, pp. 592-599

Druin, A. 2002. "The role of children in the design of new technology." *Behaviour and Information Technology*, 21 (1), Taylor and Francis Ltd., pp. 1-25

Dunmore, C. 2006. "Museum and the Web." *The responsive museum*, Lang, C., Reeve, J. and Woollard, V. Eds., Ashgate, pp. 95-114

Dysthe, O., Bernhardt, N. and Esbjørn, L. 2012. "Dialogbaseret Undervisning. Kunstmuseet som læringsrum." Skoletjeneste, Copenhagen, Denmark

Falk, J.H. and Dierking, L.D. 2000. "Learning from museums: visitor experiences and the making of meaning." AltaMira Press, Walnut Creek, CA

Falk, J. 2013. "Understanding museum visitors' motivations and learning." *Museums social learning spaces and knowledge producing processes,* Brændholt Lundgaard I. and Jensen J. T. Eds., Kulturstyrelsen Danish Agency for Culture, Copenhagen, Denmark

Fallman, D. 2003. "Design-Oriented - Human Computer Interaction". *Proceedings CHI2003, Human Factors in Computing Systems*, ACM Press, Fort Lauderdale, Florida, USA, pp. 225-232

Fienup-Riordan, A. 1999. "Collaboration on Display: A Yup'ik Eskimo Exhibit at Three National Museum." *American Anthropologists*, 101 (2), American Anthropologist Association, pp. 339-358

Firestone, W. A. 1993. "Alternative Arguments for Generalizing From Data as Applied to Qualitative Research." *Educational Researcher*, 22, American Educational Research Association, Sage, pp. 16-23

Fleming, D. 2005. "Managing change in the museum". *Keynote address at The museum and change international conference 2005*, National Museum Prague, Czech Republic

Frayling, C. 1993. "Research in Art and Design." *Royal College of Art Research Papers*, 1 (1), Royal College of Art, London, UK, pp. 1-5

Göncü, A. 1999. "Children's Engagement in the World. Sociocultural Perspectives." Cambridge University press, New York

Graham-Campbell, J. and Valor, M. 2007. "The Archaeology of Medieval Europe. Vol.1. The Eighth to Twelfth Centuries AD." Barnes and Noble, New York, USA

Graves-Brown, P. M. 2002. "Matter, Materiality and Modern Culture." Routledge, London, UK

Hall, T. and Bannon L. 2005. "Cooperative design of children's interaction in museums: a case study in the Hunt Museum." *CoDesign,* 1 (3), pp. 187-218

Hallam, E. and Ingold, T. 2008. "Creativity and Cultural Improvisation." Berg Publishers

Henare, A., Holbraad, M. and Westel, S. 2007. "Thinking through Things, Theorising artefacts ethnographically." Routledge, London UK

Hill, J. R. 2012. "Learning Communities: Theoretical Foundations for Making Connections." *Theoretical Foundations of Learning Environments*, Jonassen D. and Land S. Eds., Routledge, New York and London, pp. 268-285

Hooper-Greenhill, E., Sandnell, R., Moussouri, T. and O' Riain, H. 2000. "Museums and Social Inclusion, The GLLAM Report". Group for Large Local Authority Museums, October 2000

Hooper-Greenhill, E., Dodd, J., O' Riain, H., Clark, A. and Selfridge, L. 2002. "The impact of the DfES Museums and Gallery Education Programme. A summative evaluation." Research Centre for Museums and Galleries, University of Leicester, 2002

Hooper-Greenhill, E., Dodd, J., Phillips, M., O' Riain, H., Jones, C. and Woodward, J. 2004. "What did you learn at the museum today? The evaluation of the impact of the Renaissance in the Regions Education Programme in the three Phase 1 Hubs (August, September and October 2003)". Research Centre for Museums and Galleries. Museums Library and Archive Council, London, UK

Hornecker, E. and Stifter, M. 2006. "Learning from Interactive Museum Installations About Interaction Design for Public Settings." *OZCHI 2006 Proceedings of the 18th Australia Conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments*, Sydney, Australia, 2006, pp. 135-142

Hornecker, E. 2008. "I don't understand it either, but it is cool – Visitor Interaction with a Multi-Touch Table in a Museum." *Proceedings of IEEE Tabletop 2008*, IEEE

Hosker, R., Knowles, C. and Rodger, N. 2014. "Cross Cutting Concepts for Change: Collections – Alignment – Engagement." *Proceedings on Nodem, Engaging Spaces. Interpretation, Design and Digital Strategies*. December 1-3 2014, Warsaw, Poland, pp. 62-68

Huizinga, J. 1950. "Homo Ludens. A study of the play element in culture." Boston Beacon Press, Boston, USA

Huizinga, J. 1937. "The Waning of the Middle Ages. A Study of Forms of Life, Thought, and Art in France and the Netherlands in the Dawn of the Renaissance" Edward Arnold and co

Iversen, O. S. and Smith, R. C. 2012. "Connecting to Everyday Practices. Experiences from the Digital Natives Exhibition." *Heritage and Social Media.* Understanding heritage in a participatory culture, Giaccardi, E. Ed., Routledge, pp. 126-144

Janes, R. 2009. "Museums in a Troubled World: Renewal, Irrelevance, or Collapse?" Routledge, London, UK

Jensen, S. 1991. "Ribes Vikinger." Den Antikvarisk Samling i Ribe, Ribe, Denmark

Jones, J. C. 1963. "A method of systematic design." *Conference on Design Methods*, Jones, J. C. and Thornley, D. Eds., Pergamon Press, Oxford, UK

Jordan, B. and Henderson, A. 1995. "Interaction Analysis. Foundations and Practice." *The Journal of the Leaving Sciences,* Erlbaum Associates Inc., 4 (1), pp. 39-103

Jönsson, B. 2006. "Rehabilitation technology, design and pedagogy." *Design side by side,* Jönsson, B. Ed., Studentlitteratur, pp. 121-147

Jupp, V. 2006. "The Sage Dictionary of Social Research Methods." Sage

Kaltenbrunner, M. and Bencina, R. 2007. "reacTIVision: a computer-vision framework for table-based tangible interaction." *Proceedings of TEI 2007 The First International Conference on Tangible and Embedded Interaction,* ACM, New York, USA, pp. 69-74

Kensing, F. and Blomberg, J. 1998. "Participatory Design: Issues and Concerns." *Computer Supported Cooperative Work,* 7, Kluwer Academic Publishers, The Netherlands, pp. 167-185

Kress, G. 2010 "Multimodality. A social semiotic approach to contemporary communication." Routledge

Lang, C., Reeve J., and Woollard, V. 2006. "The Responsive Museum: Working with Audiences of the Twenty-First Century." Ashgate Pub Co

Law, J. and Callon, M. 1992. "The Life and Death of an Aircraft: A Network Analysis of Technical Change." *Shaping Technology/Building Society,* Bijke, W. E. and Law J. Eds., The MIT Press, Cambridge, Massachusetts, London, UK, pp. 21-52

Le Goff, J. "The Intellectuals in the Middle Ages." 1993, Blackwell, Oxford

Levina, N. 2005. "Collaborating on Multiparty Information Systems Development Projects: A Collective Reflection-in-Action View." *Information Systems Research*, 16 (2), June 2005, pp. 109–130

Lischke, L., Dingler, T., Schneegaß, S. van der Vaart, M., Wozniak, P. and Schmidt, A. 2014. "Parallel Exhibits: Combining Physical and Virtual Exhibits." *Proceedings on Nodem, Engaging Spaces. Interpretation, Design and Digital Strategies*. December 1-3 2014, Warsaw, Poland, pp. 149-156

Löwgren, J. and Stolterman, E. 2004. "Thoughtful Interaction Design. A Design Perspective on Information Technology." 2004, MIT Press

Lyons, L., Tissenbaum, M., Berland, M., Eydt, R, Wielgus, L. and Mecthley, A. 2015. "Designing Visible Engineering: Supporting Tinkering Performances in Museums." *Proceedings of IDC '15*, June 21 - 25, 2015, Medford, MA, USA, pp. 49-58

Marchetti, E. and Petersson Brooks, E. Accepted. "Accessing historical knowledge in the context of playful interactions and object-mediated forms of play Journal article, peer-review." Research paper, peer-review, accepted. *International Journal of Universal Access in the Information Society (UAIS), Special Issue "Ludic Engagement Designs for All (LEDA) ArtAbilitation and GameAbilitation."* Springer

Marchetti, E. 2013. "Playful learning culture in the museum. MicroCulture and Guided Tour Practice." Book chapter, peer-review, published in *Teaching and Learning Culture. Negotiating the Context*, Kirkebaek, M. J., Du, X., and Jensen, A. A. Eds., October 11 2013, Sense Publisher, Rotterdam, The Netherlands, pp. 129-144 (Paper 4).

Marchetti, E. and Valente, A. 2013. "Diachronic perspective and interaction. New directions for innovation in historical museums." Journal article, peer-review published in *The Technology Collection. International Journal of Technology, Knowledge and Society,* 8 (6), 2012-2013, Common Ground Publisher, pp. 131-143 (Paper 5)

Marchetti, E. and Petersson Brooks, E. 2013. "Setting conditions for learning. Mediated play and sociomaterial dialogue." Presented at the *Second International Conference, DUXU 2013, Held as Part of HCI International 2013*, Las Vegas, NV, USA, July 21-26, 2013, published as book chapter in *Lecture Notes in Computer Science*, Vol. 8013, PART 2. Marcus, A. Ed., Springer Berlin Heidelberg : Springer Publishing Company, 2013. p. 238-246

Marchetti, E. and Petersson Brooks, E. 2012a. "From lecturing to apprenticeship: introducing play in museum learning practice." Full paper, peer-review, published in the *Proceedings of eL&mL 2012: The Fourth International Conference on Mobile, Hybrid, and On-line Learning,* Valerdi, J., Krämer, B., and White, S. Eds., January 30 – February 4, Valencia, Spain, International Academy, Research, and Industry Association (IARIA), pp. 94-99 (Paper 2)

Marchetti, E. and Petersson Brooks, E. 2012b. "Playfulness and Openness: Reflections on the Design of Learning Technologies." Book chapter, peer-review, published in *Arts and Technology. Lecture Notes of the Institute of Computer Sciences, Social Informatics and Communication Engineering (LNICST)*, Brooks, A. L. Ed., Springer Publishing Company, 101, 2012, pp. 38 – 45 (Paper 3)

Marchetti, E. and Petersson Brooks, E. 2012c. "Moments of Play, Digital technology and museums as playful learning environments." Research paper, peer-review. *Proceedings of Designs for Learning Conference 2012*, 25-27 April 2012, Aalborg University Copenhagen

Marchetti, E. 2012. "MicroCulture. Interactive storytelling and learning in museums." Short paper, peer-review. *Proceedings of Digitel 2012, 4th IEEE International Conference on Digital Game and Intelligent Toy Enhanced Learning*, 27-30 March 2012, Takamatsu, Kagawa, Japan

Marchetti, E. and Nandhakumar, J. 2011. "On the edge between tradition and innovation. Reassembling museums as emerging creative organisations." Full paper, peer-review, published in the proceedings of the *27th EGOS Colloquium Program*, EGOS Digital Library, European Group for International Studies Colloquium, Sage, July 6 – 9 2011, Gøteborg, Sweden (Paper 1)

Marchetti, E. 2011a. "Story telling and riddle games. An ethnographic enquiry about museum guided tours." Research paper, peer-review. *PINC 2011 Participatory Innovation Conference*, 13-15

January 2011, MCI Centre of Product Innovation, University of Southern Denmark. (Marchetti 2011a)

Marchetti, E. 2011b. "Myth and bones. Museum social-epistemic practice and children's values." Research paper, peer-review. *The 23rd International Conference on Systems Research, Informatics and Cybernetics – InterSymp IIAS 2011*, 1-5 August 2011, Baden Baden, Germany (Marchetti 2011b)

Mason, M. 2015. "Prototyping practices supporting interdisciplinary collaboration in digital media design for museums." *Museum Management and Curatorship*, 30 (5), Routledge, 394-426

Mazzone, E., Horton, M. and Read, J. 2004. "Requirements for a Multimedia Museum Environment." *NordiCHI 2004*, Tampere, Finland, pp. 421-424

McCaw, C., Morgan, O. and Glen, L. 2014. "Restaging a Garden Party: Sharing Social Histories through the Design of Digital and Material Interactive Experiences." *Proceedings on Nodem, Engaging Spaces. Interpretation, Design and Digital Strategies*. December 1-3 2014, Warsaw, Poland, pp. 19-26

Moore, C. 2015. "Embracing change: museum educators in the digital age." *Journal of Museum Education*, 40 (2), pp. 141-146

Muise, K. and Wakkary, R. "Bridging Designers' Intentions to Outcomes with Constructivism." *Proceedings of the 8th ACM Conference Design of Interactive Systems*, Aarhus, Denmark, 2010

Muller, M. J. and Druin, A. 2003. "Participatory Design: The Third Space in HCI." *The Human Computer Interaction Handbook*, L. Erlbaum Associates Inc., Hillsdale, NJ, USA, pp. 1051-1068

Muratsu, K., Ishiyama, A., Kusunoki, F., Inagaki, S. and Terano, T. 2014. "Stamp-On in a Museum: Helping Children's Scientific Inquiry." *Proceedings of IDC'14,* June 17, 2014, Aarhus, Denmark, pp. 233-236

Papert, S. and Harel, I. 1991. "Situating Constructionism." *Constructionism: Research Reports and Essays, 1985-1990*. I. Harel and Papert, S. Eds., Ablex Pub. Corp. pp. 1–11

Petersson, E. 2006. "Non-formal learning through ludic engagement within interactive environments." Malmö högskola, Lärautbildningen, Malmö, Sweden

Petersson, E. and Brooks, A. 2006. "Virtual and Physical Toys: Open-ended Features for Non-formal Learning." *CyberPsychology and Behavior*, 9 (2), pp. 196-199

Pierroux, P. 2010. "Guiding Meaning on Guided Tours." *Inside Multimodal Composition*, Morrison A. Ed., Chapter 14, pp. 417-450. Hampton Press, Cresskill, NJ

Pink, S. 2007. "Doing Visual Ethnography." Sage, Los Angeles, London, New Delhi, Singapore, Washington

Piva, E., Rentocchini, F., and Rossi-Lamastra, C. 2012. "Is Open Source Software About Innovation? Collaborations with the Open Source Community and Innovation Performance of Software Entrepreneurial Ventures." *Journal of Small Business Management*, Social Science Research Network, 50 (2), pp. 340-346

Preece, E., Rogers, Y., and Sharp E. 2011. "Interaction Design, Beyond Human Computer Interaction." John Wyley and son, New York

Prensky, M. 2001. "Digital Natives, Digital Immigrants." *On the Horison*. 9 (5), pp. 1-6

Price, S. Rogers, Y., Scaife, M., Stanton, D. and Neale, H. 2003. "Using 'Tangibles' to Promote Novel Forms of Playful Learning." *Interacting with Computers*, 15(2), pp. 169-185

Reeve, J. 2006. "Prioritizing Audience Groups". *The responsive museum*. Lang, C., Reeve, J. and Woollard, V. Eds., Ashgate, pp. 43-60

Reeve, J. and Woollard, V. 2006. "Influences on Museum Practice." *The responsive museum*. Lang, C., Reeve, J. and Woollard, V. Eds., Ashgate, pp. 211-222

Resnick, M. 2004. "Edutainment? No Thanks. I Prefer Playful Learning." *Associazione Civita Report on Edutainment*, 14

Ritchhart, R. 2007. "Cultivating a Culture of Thinking in Museum." *The Journal of Museum Education*. Critical Thinking Skills in the Museum, 32 (2), pp. 137-154

Rittel, W. H. and and Webber, M. M. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences 4*. American Association for the Advancement of Science, Boston USA, pp. 155-169

Roberts, J, Lyons, L. Cafaro, F. and Eydt, R. 2014. "Interpreting Data from Within: Supporting Human-Data Interaction in Museum Exhibits Through Perspective Taking." *Proceedings of IDC'14,* June 17, 2014, Aarhus, Denmark, pp. 7-16

Roberts, T. 2015. "Factors affecting the role of designers in interpretation projects." *Museum Management and Curatorship*. Vol. 30, No. 5, Routledge, 379–393

Rogoff, B. 1990. "Apprenticeship in Thinking. Cognitive Development in Social Context". Oxford University Press, New York, Oxford

Rogoff, B. 2015. "Human teaching and learning involve cultural communities, not just individuals." *Behavioral and Brain Sciences*, 38, Cambridge University Press, pp. 42-43

Rogoff, B. 1995. "Observing sociocultural activity on three planes: participatory appropriation, guided participation, and apprenticeship." *Sociocultural Studies of Mind*. Wertsch, J., Del Rio, P, and Alvarez, A. Eds., Cambridge University Press, Cambridge, New York, pp. 139-164

Säljö, R. 2010. "Digital tools and challenges to institutional traditions of learning: technologies, social memory and the performative nature of learning." *Journal of Computer Assisted Learning*, Special Issue. Vol. 26, Blackwell, pp.53-64

Scaife Rogers, Y. 1999. "Kids as Informants: Telling Us What We Didn't Know Or Confirming What We Knew Already?" *The Design of Children's Technology*. Druin, A. Ed. Morgan Kaufman Publishers, San Francisco, USA

Schmidt, H. 1994. "Building custom in Viking Age Denmark." Aarhus University Press, Aarhus, Denmark

Schofield, A. J. 2002. "Never mind the relevance? Popular culture for archaeologists." *Matter, Materiality and Modern Culture*. Graves-Brown P. M. Ed., Routledge, London, UK, p. 135-152

Schön, D. 1994. "The Reflective Practitioners. How Professionals Think in Action." Ashgate

Silverman, D. 2005. "Doing qualitative research." Sage, London, UK

Simon, N. 2010 *The Participatory Museum*. Santa Cruz: Museum 2.0

Simon, H. 1996. "The Science of the Artificial." Third edition, first edition published in 1969. MIT Press

Star, S.L. and Griesemer, J. R. 1989. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology 1907-39." *Social Studies of Science*, 19 (3), Sage, London, Newbury Park and New Delhi, pp. 387-420

Stolterman, E. 2008. "The Nature of Design Practice and Implications for Interaction Design Research." *International Journal of Design*, 2 (1), Creative Commons, pp. 55-65

Sutton-Smith, B. 1997. "The Ambiguity of Play." Harvard University Press, USA

Søndergaard, M. K. and Janes, R. R. 2012. "What are museums for? Revisiting "Museum in Troubled World." *Nordisk Museologi 2012*, No. 1, pp. 20-34

Tabacco, G. 1974 "Egemonie sociali e strutture del potere nel Medioevo italiano." Einaudi, Torino, Italy

Tullis, T. and Albert, B. 2008. "Measuring the User experience. Collecting, Analysing, and Presenting Usability Metrics." Morgan Kaufmann Publishers, Burlington, Massachusetts, USA

Van Leeuween, T. 2005. "Introducing Social Semiotics." Routledge, London, UK.

Villaverde, K. and Murphy, B. 2012 "Senior Project: Game Development Using Greenfoot." *The Journal of Computing Sciences in Colleges*, 27 (4), The Consortium of Computer Sciences in Colleges, pp. 159-167

Vygotsky, L. 1987. Zone of proximal development. Mind in Society: The Development of Higher Psychological Processes, pp. 52-91

Vygotsky, L. S. 1978 "Mind in Society. The Development of Higher Psychological Processes". Harvard University Press, Cambridge Massachussets, London England

Wertsch, J. V. 1991. "Voices of the Mind. A Sociocultural Approach to Mediated Action." Harvester Wheatsheaf, London, Sydney, Singapore

Woollard, V. 2006. "An unsettled Profession". *The responsive museum*. Lang, C., Reeve, J. and Woollard, V. Eds., Ashgate, pp. 221_222

Yliriksu, S. and Buur, J. 2007. "Designing with Videos: Focusing the User-Centred Design Process," Springer

Zimmerman, J., Forlizzi, J. and Evenson, S. 2007. "Research Through Design as a Method for Interaction Design Research in HCI." *Human Computer Interaction Institute*, Paper 41, pp. 1-11, http://repository .cmu.edu/hcii/41

Included papers

Paper 1

Marchetti, E. and Nandhakumar, J. 2011. "On the edge between tradition and innovation: Reassembling museums as emerging creative organizations." *27th EGOS Colloquium Program*, Sage, July 6 – 9 2011, Gøteborg, Sweden.

On the edge between tradition and innovation: Reassembling museums as emerging creative organizations.

Emanuela Marchetti
Department of Learning and Philosophy
Centre for Design, Learning, and Innovation
Department of Architecture, Design and Media Technology
Aalborg University, Denmark
ema@create.aau.dk

Joe Nandhakumar
Warwick Business School
The University of Warwick
Coventry, England (UK)
Joe.Nandhakumar@wbs.ac.uk

Sub-Theme 12. Revisiting Innovation: Reassembling Spaces and Actors in Organizations

1. Abstract

Museums are undergoing an organizational shift, regarding their role within society and professional competences. This shift is often depicted as positive, turning museums into more democratic, creative, and efficient organizations (Fleming 2005). Others claim, however, that an innovation process cannot succeed, if it is not supported by a favourable global network, providing a negotiation space (Law and Callon 1992). Starting from this theory, we analyze the case of two local museums, in order to gain insights into museum innovation and the emerging interplay with traditional practices. We investigate also how external pressure from a network, apparently supporting innovation, may instead create a conflicting system of values, compromising the emergence of a negotiation space and hindering the innovation process.

Our study suggests that museum innovation is still unsettled, on the edge between tradition and innovation, because it is being negatively affected by a global network claiming to support innovation, but in reality denying a negotiation space and demanding for traditional practices to be preserved.

Therefore, according to museum practitioners innovation is hindered by a conflicting system of values, creating a “double bind” dynamics (Bateson 1972), which denies a clear way to succeed in achieving innovation and a new organizational identity.

Therefore, innovation practices are confined within safe spaces, that we call *innovation enclosures,* such as temporary/thematic exhibitions, coexisting aside of traditional, often criticized, practices.

2. **Introduction**

Traditionally museums saw themselves as cultural authorities (Reeve and Woollard 2006), performing a major cultural role within society, as they were dedicated to the preservation of antiquities and of the knowledge embodied in them. In recent years museums became concerned with their visitors and the quality of the service they provide to them, from a learning and entertainment perspective (Crowley and Jacobs 2002, Marchetti 2008). Therefore, museum professional competences, its role within society, and organizational identity are being deeply questioned by museum practitioners, but also by funding and educational institutions, and by researchers active in the field of humanities, culture, and design. Apparently this phenomenon started from the concern of attracting more visitors (Crowley and Jacobs 2002) and from a desire of assessing reputation and quality of museum experience from visitors' perspective (Hooper-Greenhill 2004, Fleming 2005, Marchetti 2008). Researchers claim that this process is necessary and is increasing the quality of museum services, making museums more democratic and accessible. New learning and entertaining activities are being arranged and more attention is being paid to disabled people and different age groups, such as children or teenagers (Crowley and Jacobs 2002, Fleming 2005, Reeve 2006).

However, at a closer look this process seems to be unsettled, even in contexts where it started 10 years ago, and design researchers still criticize museums' approach to learning for being traditional, unengaging, and disrespectful of young visitors' values. Generally museum experience takes the shape of a "walking" lecture moving through the exhibition space. Young people participate as a captive audience, visiting museums together with their parents or teachers often without having a personal motivation. Therefore, starting from young people's interest for digital media, design researchers propose interactive installations to bridge learning, fun, and their everyday values (Pierroux and Kaptelinin 2007, Dindler and Iversen 2009).

On a methodological level, a few studies argue that visitors could participate in exhibition planning, intended as a creative process. Hence participatory design has been defined as an effective approach to gather meaningful data and create a richer

experience from visitors' perspective (Mazzone et. al. 2007, Dindler and Iversen 2009). However, despite all these promising outcomes, digital settings are adopted only by large museums, while local ones stick to traditional practices.

According to Law and Callon (1992) organizational innovation is a complex social process, strictly dependent on the support of a favourable global network, defined as "a set of relations between an actor and its neighbours and the neighbours and others" (Law and Callon 1992 p.21). Such a network is supposed to provide a "negotiation space", including resources and a span of time, in which innovation can take place (Law and Callon 1992). Furthermore, Reeve and Woollard (2006) argue that several external "influences" are affecting museums' organizational shift. First of all funding institutions (as acknowledged also by: Crowley and Jacobs 2002, Fleming 2005) expect museums to become more effective in proving the relevance of their cultural role within society and in managing their resources (Reeve and Woollard 2006). Furthermore, museums have been associated as "adjunct to the school system", so that they have to adapt to the same "functional over-assessed approach to learning" and the same restrictive curriculum applied to schools (Reeve 2006 p.50[1]); therefore, museum practitioners' freedom to innovate results pretty much constrained.

Such pressures destabilize museum innovation through a sort of "double bind", defined by Bateson as a situation in which no matter what, it is not possible "to win" (Bateson 1972). Lacking the necessary skills and a clear direction to pursue, museum practitioners have confined innovation practice to safe peripheral areas, such as temporary or thematic exhibitions, which allow creative explorations without endangering the quality of the permanent exhibition, museum reputation, and negotiation power.

We introduce the concept of *innovation enclosures* to critically analyze museum innovation process and the emerging interplay with traditional practices. In our view, a more favourable context would have supported this process, by promoting innovation enclosures into "wakes of innovations" (Boland et al. 2007), spreading beyond museums to the external organizations involved.

Starting from these theories and our findings, we argue that museum organizational shift is a case of unsettled innovation process, hindered by an unfavourable network, exercising conflicting pressures.

In the next section we introduce context and method of our study. In section 4 we

1 This is referred specifically to museums in UK.

present an analysis of traditional museum practice, then in section 5 a discussion about our analysis of museum innovation; finally in section 6 conclusions and future works are discussed.

3. The study

3.1 Method

This study is structured as a design oriented research, based on ethnomethodologies such as: situated interviews, interpretive analysis of video material, and participatory design. By design oriented research, we refer to Fallman's definition of theoretical investigations conducted by creating and testing design outcomes, which are relevant only in relation to the theoretical insights they can provide (Fallman 2003).

Our aim in this study is to investigate museum organizational change in relation to external pressure and the emerging interplay between innovative and traditional practices. We started with a user study, to reach an understanding of museum practice from the perspective of both museum practitioners and visitors. We interviewed museums staff (curators, museologists, educators, and guides) to reconstruct museum practice and their perspective about it, focusing on their dilemmas and professional values. Each interview took around one hour and was video-recorded for further analysis. When possible interviews were held in situ so to be as close as possible to interviewees' everyday practices. In addition participant observations were conducted during guided tours, in order to collect data about interaction and learning. Hence guides were interviewed on other occasions in the museum café and after around 30 minutes interview the tour guides were asked to demonstrate what they did when they guide children through the museum, so that we were able to collect data about their strategies in interacting with the children, how they developed them, and their reasons (Marchetti 2011).

After the first interviews, which were run in two local museums with an historical focus, we conducted an ongoing participatory design process. We invited our target group, circa 25 primary school children around 8-10 years old, to create a new playful interactive installation, aimed at supporting learning, social interaction, and engagement in historical exhibitions. Our target group was decided based on preliminary surveys, showing that primary school children are a challenging group. Apparently they seem not to create any issues, since they are described by guides as being polite and quiet. But they visit museums as a captive audience, being taken

there by adults, probably without having a real interest in the exhibition. In general it seems hard for museum practitioners to open a dialogue with them and gain an understanding on their interests, on what they are actually learning, and eventually on how they would like their museum experience to be. Therefore, the aim of the participatory design process was to gain meaningful insights about children's perception of museum learning and communication practices, actively provoking innovation, so to envision future scenarios and gain a deeper understanding of museum innovation processes and possible new directions. The participatory design sessions were held at an after school institution. We started with discussing museum experience from their perspective, afterwards they were involved directly in developing a low-fidelity prototype of the installation, that was presented as a game about the Viking time. They engaged in making artefacts for the installations with different materials such as: building bricks, play dough, and paper. A design "collaboratorium" was then established in their facilities, we created a space where we could design together, leave our prototypes, and collect them later for further reflections if needed (Buur and Bødker 2002).

3.2 Context

Our study focuses on two small but active museums: The Viking Museum in Ribe (Denmark), and The Transport Museum in Coventry (England).

The Viking Museum in Ribe offers a permanent exhibition of local findings dated from Prehistory to the Renaissance, to tell the story of the oldest Danish town. The museum is in fact so popular, also among foreigners, because Ribe is officially the first town in Denmark. The original settlement was a seasonal market place, where merchants came every summer to sell their goods. Then around 700 King Godfred divided the land of the market site into small lots and rented them out to the merchants to collect more taxes. Hence people started to occupy the land on a more permanent basis and the market place was turned into a village. During the Viking Age the settlement flourished and in the 10th century King Harald Blueetooth, the first king of the unified Danish kingdom, turned Ribe into the first Danish town, by restructuring the village and the market area, and by having defensive walls built around the whole settlement (Graham-Campbell and Valor 2007).

The Transport Museum in Coventry, West Midlands (England), focuses on the relations between the local transportation industry and the development of the town.

Since the Victorian and the Edwardian times many bicycle makers chose Coventry to open their factories, then in more recent times they were followed by luxurious cars manufacturers, like Jaguar and Porches. This phenomenon had strong implications for the people living in the town, it meant that many inhabitants were employed in those factories, and, according to the museum curator, cars were more common than in other towns and roads were well kept, in order to efficiently connect residential and industrial areas.

These two museums were chosen because they both have an historical focus, they have small but highly praised collections and are aimed at disseminating knowledge about the history of their local communities, also on the outside, promoting their tradition and cultural identity. Finally they are both undergoing through an organizational change, becoming creative organizations that are exploring new ways to engage with their audience. Moreover, they allow us to test our theories in two different cultural contexts, providing more information and richer insights, about museum organizational change and the relevance of our study.

4. An analysis of traditional practice in historical museums

4.1 Sociomateriality and walks through time

Typically historical museum practice is associated with the discovery and preservation of ancient artefacts, in some cases the museum itself is involved in conducting research, while in others it can collect materials from privates and from excavations conducted by research institutions. But generally it seems as preservation of artefacts is the main reason for the existence of museums (Graves-Brown 2002).

Ancient artefacts have always been assigned a great cultural value by our society, as they embody knowledge and meanings related to our cultural identity, reminding us of the past in the ongoing continuity of the present (Graves-Brown 2002, Marchetti 2008). Museums had also the important role of sharing with the public the knowledge embodied in their collections through exhibitions and cultural events, and in this respect they were seen as “uncontested authorities” (Reeve and Woollard 2006).

Generally it seems as museum practitioners saw the public as a reflection of themselves, adult people who have a personal interest for ancient artefacts and the knowledge embodied in them (Reeve and Woollard 2006, Hooper-Greenhill et al. 2007). Moreover, schools have always been a typical user of museums, usually

attending guided tours. This means that it was assumed that the visitors knew already a lot about the museum collection, or that they were guided through the exhibition by an expert, hence very little effort was made in order to allow visitors to concretely learn something on an independent basis. Exhibitions were the only way museums communicated with the public, so that the material setting of the exhibition and its content, including historical and explanatory artefacts, such as signs placed close to the antiquities (Ill. 1), provided an indirect contact between visitors and museum practitioners. In this sense the displayed objects play the role of “boundary” and “epistemic” objects, as they allow communication among different groups of people, coming from different backgrounds but sharing a common interest in engaging in a discourse about the exhibition content and the knowledge it embodies (Star and Griesemer 1989, Ewenstein and Whyte 2005). Therefore, museum learning practice can be defined as a form of “sociomateriality” (Orlikowski 2007), intended as an entanglement of social interaction and materiality. Hence verbal and non-verbal communication are deeply intertwined both within a group of visitors, but even more between guides and visitors. Guides seem to lead the tour through physical movements, they communicate to the visitors which objects they want to talk about, simply by stopping next to them, moving their hands towards the objects, turning to the visitors, and starting their story. Then they would simply move further when they decide it is time to see other things (Marchetti 2011). Interestingly they also try to understand what young visitors are interested into, by looking “at what they are looking at”, so to dynamically shape a story that is relevant for them (Marchetti 2011). According to our observations, displayed objects provide starting points and illustration for the “story” being told to the visitors. Guides in fact see their job mainly as “telling a nice story”, especially to children, something that “they could remember”, eliciting more curiosity for the past and also in investigating further “their own identity” from an historical perspective (Marchetti 2011).

Interestingly the historical perspective, intended as chronological sequence, represents the dominant paradigm regarding the structure of exhibitions, as shown by the permanent exhibitions both in Ribe and Coventry. According to practitioners from these museums, learning of history has always been associated with memorization of a sequential narrative, from a remote past until more recent times. This paradigm is adopted by museums, so that the exhibition is shaped as a materialization of a sequential line through time. Hence artefacts are grouped first according to their chronology and then by kind (Ill. 2, 4). The aim of this approach

seems to be to show how a certain civilization progressed in time. Thence a visit or a guided tour, in an historical museum, acquires the shape of a walk through time, moving from a distant period in the past towards more recent times.
Moreover, this paradigm is adopted also by schools, in which history is being taught as a long sequence of events, placed at different points on the same time-line, one age or civilization after the other. In this sense museum approach to learning is very much compatible with the way children are taught in schools, which means that teachers can easily integrate a museum visit into the historical discourse they are holding with their class (Woollard 2006).

4.2 Sacred and Mundane objects

The main focus of historical museums exhibitions are old artefacts, which are somehow invested of a sacred aura. They are perceived as relics coming from the past, they were created by people belonging to disappeared civilizations, but still they can be seen any time by visiting a museum.
Furthermore, such artefacts are segregated from the visitors, from a cognitive and physical perspective. Ancient artefacts in fact have been transmuted through time and in some cases they can be recognized only by an expert eye, in this sense they are cognitively segregated from the visitors. First of all many artefacts are only fragments, or because they came from a trash well and were thrown away by the owners in historical times, or because they were damaged by remaining in the ground for centuries. In fact repeated agricultural practices on the ground may have destroyed them, or a long permanence under the ground may have caused significant alterations to the structure of the materials these objects are made of, determining physical-chemical reactions, so that metallic objects become rusty or organic materials like cloth of wood can simply rot and disgregate. Hence ancient objects are displayed behind glasses, to preserve them from dust and humidity, which may irremediably ruin such objects, but also to avoid visitors to manipulate them and cause even more damages. As a result the typical material configuration of historical displays is a sequence of huge shelves closed by glass windows (Ill. 1, 2). Moreover, this configuration seems to reinforce the sacral perception of ancient artefacts, showing clearly that special care has to be taken to preserve them.
In order to bridge between visitors and the knowledge embodied by the displayed artefacts, mundane objects, such as signs, posters, brochures or even catalogue are

made available. These objects do not have any particular importance by themselves, they are used to tell the visitors simple information about the displayed objects, such as what is that they are seeing, from which period is dated, when and where it was found.

More recently, in relation to museum organizational shift, mundane objects have assumed a more valuable role and have proliferated in kinds, including also walk-through, interactive installations, copy or authentic artefacts, and even play areas. These objects can be defined as mundane, because they are available for people to enjoy, who are supposed to touch and even play with them. The purpose behind the introduction of such artefacts is to enrich people's experience of museums, by making it more immersive, somehow trying to shorten the time distance between the past and the present, so to support learning and engagement. Museal installations are also aimed at contextualizing the ancient artefacts regarding the society within which they were produced, so to be better understood. In this respect, guides feel a special responsibility as they think that guided tours are “the most effective tools to allow visitors, especially children, to gain a deeper understanding of the exhibition[2]”. Furthermore, both ancient artefacts and installations are consciously used by curators and guides, to stimulate visitors on an imaginative and emotional level, eliciting a lively perception of how it could have felt to be at that particular time (Marchetti 2011).

However, regarding the different essence of museums artefacts, it seems as mundane objects are not always of the same kind, since some installations can be physically approached while others may be intended only to be seen. For instance the walk-through Medieval and Viking installations in the permanent exhibition in Ribe are not supposed to be engaged physically, visitors are only supposed walk through and observe them. On the contrary a copy of a Viking ship, displayed just opposite to the walk-through installation, is intended for people to sit and enjoy (Ill. 3). Guides usually ask visitors to sit on the ship, so to provide them with a lively feeling about how it could have been to navigate on a Viking ship for days during a military expedition (Marchetti 2011).

Our study suggests that in Ribe the sacral character of ancient artefacts is effectively conveyed and well accepted by visitors, but it seems as having different kind of installations associated with different expected behaviors, can create confusion from the visitors' side. Hence most people do not dare to engage with the Viking ship, as

2 Quotes from interviews with guides at the Viking Museum in Ribe, 3 November 2010.

they are not sure if it was intended for that purpose or not, unless they are explicitly invited by guides to do so.

Illustration 1: Fragments from a Viking ship with visual explicative signs.

Illustration 2: Permanent exhibition in Ribe.

During a free visit with the children cooperating to the design process, they felt uneasy when they were invited to sit on the copy of a Viking ship and asked puzzled: “But can we really sit here?”. The same response was expressed also by a group of school children taking a guided tour during one of our participant observations.

Illustration 3: Children engaging with Viking ship.

Instead in the museum in Coventry the curator and the head educator complained that people are constantly asking to touch or even sit on the cars displayed at the exhibition. According to them this may happen because people tend to “relate to cars as everyday objects”, thence “they do not see them as historical artefacts!”. Moreover, it seems as vehicles, especially cars, are too recent artefacts to be perceived as sacred objects, as some models were even invented during the lifetime of the visitors. This means that these artefacts have not been materially transmuted through time as it happens for more ancient artefacts, hence they are not cognitively segregated from the visitors in the same way as the ones displayed in Ribe. Furthermore, the lay-out of the exhibition space in Coventry is a bit unusual, as the cars and other vehicles are freely placed within the exhibition space and only sometimes they are separated from the visitors by a white rope, so to shape a sort of fence, as a result the cars still look quite approachable (Ill. 4, 5). Finally there are

only a few “mundane” vehicles available for people to interact with, which could elicit a feeling of frustration, particularly in the case of younger visitors, who may be willing to do more than just look at the vehicles.

On the other hand the segregation of artefacs is being used too effectively in the Viking Museums in Ribe, conveying sacrality also when not necessary. Even the Viking ship is physically segregated, it is in fact placed down a step on a blue area, so to give the impression that the visitors are walking by the sea and that the ship is tied at the dock (Ill. 3). Although the installation in itself is nice to look at, it feels unapproachable, preventing visitors from playing with it as they were supposed to, hindering their experience.

This segregation practice is quite interesting and can be interpreted as a sort of manipulation of space to create a sacred precinct, destined to authorities and that cannot be violated by regular visitors. Hence such practice could be compared with the concept of *temenos* in Ancient Greece. The word comes from the verb *témno*, which means *to cut*, and it indicated an area of land that was “cut off” and segregated from everyday living activities, so to be destined only to ritual purposes (Bruit-Zeidman and Schmitt-Pantel 1989).

Illustration 4: Old cars and rope delimiting exhibition space.

Illustration 5: Bicycles exhibition space.

Illustration 6: Young visitors engaging with a car.

Summarizing, it seems as the sacrality of ancient artefacts is strictly related to their physical and cognitive segregation. Therefore, visitors at the Viking Museum in Ribe are more willing to accept restrictions regarding access to the artefacts, as segregation is more perceived than in Coventry, where the visitors keep asking if they can touch or sit on the vehicles, especially the cars, and violate their sacrality (Ill. 2, 4, 5). Furthermore, these case studies seem to suggest that perception of artefacts sacrality through segregation, could be an interesting area to investigate in order to innovate the lay-out of historical exhibitions.

5. Discussion

5.1 On the edge between innovation and tradition

Analysis of data from the two sites allowed us to identify two main concepts: *double bind* and *innovation enclosures*, which have been fundamental in making sense of museum innovation process, in relation to external pressure and the emergent interplay between traditional and innovative practices.

As already discussed in the previous section, our study suggests that museum practice can be defined as an epistemic form of sociomateriality (Orlikowski 2007), in which learning emerges as en entanglement of social interaction and the material-semiotic configuration of the exhibition setting. Moreover, museum practitioners traditionally assumed that visitors were mainly educated adults, who had an intrinsic motivation to visit exhibitions (Reeve and Woollard 2006, Hooper-Greenhill et al. 2007), and since museums did not feel any need to attract more visitors, no attention was paid to other groups. This attitude seemed to generate a self-fulfilling dynamics, in the sense that since museum assumed that regular visitors had already deep interest and knowledge about the artefacts displayed, no much effort was made in order to elicit any interest or knowledge in other groups of potential visitors, as a result the basis of regular visitors remained quite small but stable. Hence, other groups of potential visitors were neglected, therefore, they did not engage with museums.

As part of the innovation process recently started, museums changed their attitude towards visitors and began to express concerns, regarding what visitors are actually learning from their visit and how could it be possible to open a real dialogue with them (Marchetti 2008). Interestingly, this is in contrast with the traditional view of museums as cultural “uncontested authorities” (Reeve and Woollard 2006), whose

main role was to preserve antiquities, conduct historical research, and spread their knowledge simply by opening displays for the public (Star and Griesemer 1989). According to literature, this phenomenon happened because museums were responding to a pressure from external institutions in attracting more visitors (Crowley and Jacobs 2002, Fleming 2005, Reeve and Woollard 2006), as confirmed also by the curator in Coventry. But according to our analysis, this change of perspective took place also in relation to an intrinsic motivation of curators in increasing museum impact on the local community. This motivation seemed clearly expressed by both museums, in particular by The Viking Museum in Ribe, where curators do not seem to feel a strong institutional pressure. They both seem to agree that museums mission should be to "enhance the contact with the public" and contribute more in "eliciting an awareness" about the historical identity of the local community within it and on the outside[3]. Therefore, new practices have been introduced, through exploration of new settings, creation of cultural events, and adoption of communication strategies, sometimes even hiring specialists (Fleming 2005), specifically with the aim to expand the basis of their interlocutors and to strengthen the dialogue with their regular audience. These attempts appear to bring some improvements, as the curator of the Transport Museum in Coventry pointed out: "for many years the museum was visited mostly by cars enthusiasts", who were at most "old British males", hence the actual relevance of the museum and its collection started to be critically re-examined. But as soon as they tried to communicate to other groups, the museum staff was able to expand the basis of usual visitors to other groups and nowadays the museum attracts regularly schools and families, mixed ethnicity and age groups, visiting from the area of Coventry and from other towns too.

Interestingly, even if for some museums the organizational shift began many years ago, the situation still appears unsettled. According to the curator in Coventry, his team engaged in a re-evaluation of traditional practices already around "10 years ago", so that to manage such a shift is becoming for them "an old matter". However, the organizational shift is still perceived as an ongoing process, therefore, a clear definition of museums identity as organizations and their role within society, is struggling to emerge, especially regarding learning practices and communication with the visitors (Woollard 2006).

In the next section we will reflect on the reasons causing this phenomenon and how

3 Both quotes are from interviews with the curators from Ribe and Coventry, November and December 2010.

museum practice has been affected.

5.2 Double bind

As already discussed, external pressures constitute a main factor in museum innovation, encouraging the creation of more engaging settings and a more efficient forms of management (Fleming 2005). Furthermore, current research in organizational change and innovation suggests that a favourable global network, providing resources and a negotiation space, is essential in enabling innovation to take place (Law and Callon 1992). From our data it actually seems that external institutions are posing conflicting requirements to museums, such as: to become "more creative and productive", in terms of quality of their service and of attracting more visitors, but still "keep traditional chronological accounts of history", as demanded by educational institutions. They should also become "more entrepreneurial"[4], in the sense that they should be able to optimize their resources and significantly innovate their practice,

These requirements, which have strong implications for the future of museum identity and everyday practice, were formulated by external funding and educational institutions, in order to increase quality and efficiency of museum activities, from their own perspective. However, according to our studies, such requirements do not represent fairly enough the perspective of museum practitioners. As already discussed, museums in UK have been assigned under the same coordination of the school system, which means that they have to conform to the same educational curriculum (Woollard 2006). Unfortunately, according to literature and to the curators in Coventry, the prescribed curriculum is very restrictive, in terms of the topics to cover and even regarding how they should be taught (Woollard 2006). Interviews with the head educator at the Transport Museum revealed that, although they have been encouraged in trying new ways, in reality their enthusiasm for creative exploration in exhibitions planning and learning techniques, are constantly frustrated by teacher's prosaic expectations. Teachers in fact demand for their pupils "a pure chronological narrative", which "is easy" to discuss in class and "fits well with the objectives of their teaching programme". The need for a chronological narrative has certainly a pedagogical value, which is perceived in Denmark as well, and seems to explain why in both museums the main exhibition has always been structured as a

4 Quotes from the curator of the Transport Museum, interview dated to 15th December 2010. The same terms are used in literature (Fleming 2005, Reeve and Woollard 2006).

walk through time, even though museum practitioners criticize this approach for being too “old fashion” and not very creative.

Considering all these elements from a general perspective, it seems as the process of museums innovation is not being adequately supported by the external institutions constituting the global network, who are promising and denying a negotiation space at the same time. All these external institutions are in fact posing conflicting and constraining requirements, in order to support museum innovation, however, in so doing they generate also a meta-level contradiction, taking a great deal of ownership on the whole process and relegating museums to a more passive role. As a result traditional practices are still retained within museum practices, mostly because they makes sense for external institutions, but do not necessarily meet museum practitioners' needs.

Furthermore, since the external institutions expect every new activities planned by the museum to be “a success”, in terms of money management and public satisfaction, according to the curator in Coventry, the request to become more entrepreneurial “does not leave any space to make mistakes”, which is necessary in order to creatively explore new practices.

Finally such requirements assume skills and values related to the fields of design and management, without showing any respect for the professional skills and values belonging to museum practitioners, who are usually (art) historians or archaeologists. For instance a common issue for both museums is represented by the difficulty of opening a dialogue with the public, it seems in fact as museum practitioners lack the necessary skills to conduct a user survey by themselves, as it has become common practice in the design field. According to our interviewees, they try to innovate simply “following their intuition”, as they do not have any methodological knowledge related to the design domain, and “do not really know what visitors like or dislike” of the current settings. Therefore, both museums have attempted to open a dialogue with their visitors and to learn what they need in order to sensibly innovate their practice. Professionals were hired in Coventry to run a marketing survey, which unfortunately did not give meaningful results. Then the curator from Ribe Viking Museum has been travelling abroad to take courses in user driven innovation, and during his previous working experience at a local museum in Viborg (North Jutland), he participated to the planning of a new exhibition, which was evaluated through an informal test organised together with a school, so that “a class of children visited the museum and gave feedback through a questionnaire”.

Interestingly our interviewees claim to appreciate creative practices, they recognize in them theoretical and ideological standpoints they gained from their backgrounds, since according to the curator from the Transport Museum in Coventry: they “all come from arts related educations”. It seems in fact as, despite their lack of formal design knowledge, they found themselves thinking almost as interaction designers when attempting explore new activities. On the other hand, they do not value managerial practices in the same positive way. Therefore, it appears as curators and other staff from both museums would prefer to embrace a new identity as creative practitioners, while the requirement of “becoming entrepreneurial” is perceived as not suitable and even disrupting the shifting process.

Considering theoretical and empirical evidences, we claim that external pressure is perceived by museum practitioners as creating a sort of *double bind.* According to English anthropologist Gregory Bateson a double bind is a situation in which “no matter what” it is impossible to “win” (Bateson 1972, p.156). Bateson analyzed this dynamics as a main factor in causing the emergence of identity disorders in individuals, which are at the basis of pathologies such as schizophrenia (Bateson 1972). In our view, the current situation of museum organizational shift is trapping museums into a sort of double bind, as on a more direct level museums global network is setting conflicting requirements, expecting museums to become more creative but also more entrepreneurial, and then on a meta-level promising and denying a negotiation space, hence not allowing the possibility to successfully achieve innovation and a new desired identity as creative organizations.

5.3 Innovation Enclosures

As discussed before curators from both museums complain that their permanent exhibitions are “traditional and old”, they were planned “many years ago” and were never re-conceptualized in depth. They both are arranged as chronological accounts focused on the artefacts and approaching visitors only as receivers in “a one way communication”[5].

Interestingly these exhibitions seem to represent the traditional values (as discussed in: Reeve and Woollard 2006, Reeve 2006), but according to the statements of our interviewees such values do not represent museum practitioners any more. Hence our study suggests that museum practitioners simply do not dare to touch the

5 Quotes from interviews with curators in Ribe 22nd November and in Coventry 15th December 2010.

permanent exhibition, despite their dissatisfaction, not to endanger the quality of their service, their reputation, and consequently their credibility and negotiation power within their global network. As a result, museum practitioners ended up with confining their creative explorations to what we call *innovation enclosures:* peripheral activities, such as occasional cultural events, learning activities with schools, and temporary or thematic exhibitions. Such innovation enclosures seem to supply for the lack of a proper negotiation space and to provide safe spaces for trial and error experiments, which are apparently not allowed by the institutions constituting the global network in the process of museums innovation. Probably our study was welcomed, as it represented another innovation enclosure.

Both in Ribe and Coventry a few thematic settings have been organized in recent years, in order to experiment new sociomaterial practices. In August 2010 a new temporary exhibition, *Why Ribe?,* was started at Ribe Viking Museum (Ill. 7, 8, 9). It was conceptualized by the director and the head museologist to convey the tentative nature of the historical reconstruction process, through a series of low-tech interactive installations, mainly targeted to families and the younger audience (Marchetti 2011).

Illustration 7: Why Ribe? Exhibition setting.

Illustration 8: Why Ribe? Interactive display with cabinet showing how artefacts look at excavations.

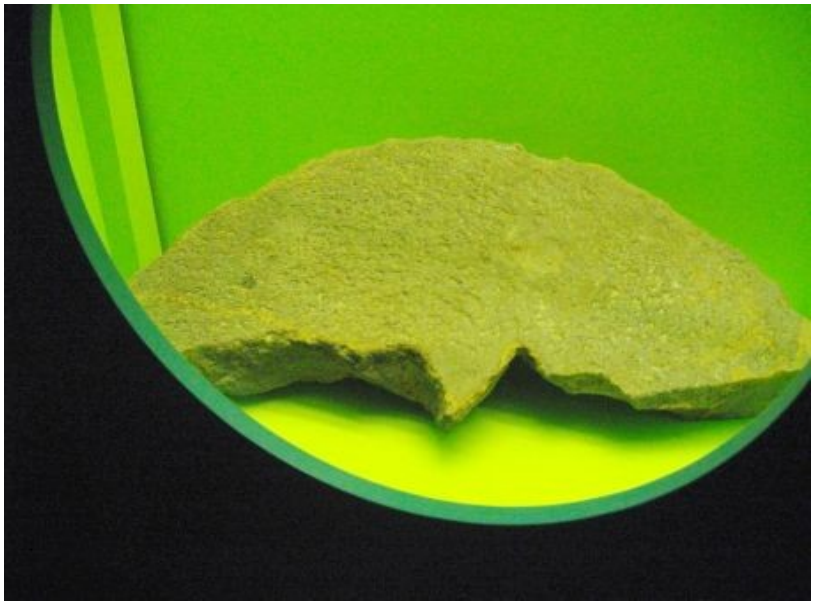

Illustration 9: Fragment of medieval a millstone placed inside an interactive cabinet.

Their intention was to challenge the “traditional assumption” that museum practitioners know “the truth!”[6] about the past and that it is their duty to share this knowledge with the public through visual exhibitions. Hence the exhibition was provocative from the double perspective of interaction and of learning content: it was in fact conceived so to encourage visitors to engage physically with the displayed installations, then it also aimed at telling people that historians “do not know the truth”, they just “attempt” to reconstruct “what it *could* have been”, elaborating hypothesis based on excavations context, material findings, and ancient documents.
Similar experiments are being made in the Transport Museum in Coventry too, a few years ago, the curator in Coventry invited design students to create a new setting aimed at representing the time when cars factories closed. This is a very sensitive subject, as it caused a dramatic increase of unemployment among the local population and, more importantly, a feeling of “identity loss” for the whole community, interrupting a tradition that distinguished Coventry among other similar towns on a national scale. The result of their work is a thematic exhibition space entitled: *Ghost Town - What happened to Coventry car industry?.*

Illustration 10: Ghost Town exhibition space in Coventry.

6 Quote from an interview with the director and the head museologist of South-Western Jutland Museums, the interview took place before starting the project in December 2009.

Illustration 11: Reconstruction of a boarding room. On the screen video clips about the closing of the factories.

Illustration 12: Visual contrasts in the Ghost Town space.

This setting still visible in a wing of the museum, showing vehicles produced by the local factories who closed, and walls covered with headlines from national and local newspapers commenting on the event and its socio-economic implications (Ill. 10, 11, 12). Walking through the exhibition, visitors can acquire an awareness about the story of Coventry car industry and its distinguished culture, by looking at the cars and reading the headlines, which effectively provide a feeling about how people related to that crisis. They can also visit the reconstruction of a boarding room, in which papers were signed to officially notify the decision of closing one of the factories (Ill. 11). The whole space has been conceived to create a dramatic effect, well expressed by the visual contrasts between the dominant colors: red, black, and white (Ill. 12).

The curator was very satisfied with the result, as it elicited strong feelings in the audience, from his perspective he succeeded in involving the visitors in a sort of "discourse", by provoking them at an emotional level. He also added that some visitors in fact commented positively on the display, as it elicited personal memories from that time, while others reacted negatively, claiming that the organization of such an exhibition "was inappropriate and inconsiderate", especially towards the people who lost their jobs.

In our view, it seems as museum practitioners are creating peripheral activities, so to gain more ownership on the innovation process. Furthermore, a supportive network would have facilitated the emergence of a negotiation space since the beginning, or at least it would have promoted innovation enclosures as an official element of the innovation process, acknowledging more decisional power to museum practitioners, so to better represent their values. Hence the results produced through innovation enclosures could have started "wakes of innovation", spreading to funding and educational institutions (Boland et al. 2007), allowing museums to gather new resources and more independence in pursuing innovation, and to establish a new professional identity as creative organizations, which suits well their professional values.

6. Conclusions and future works

According to the current literature, museums are going through a necessary organizational shift, which is improving the quality of museums' services (Crowley and Jacobs 2002, Fleming 2005).

However, according to Law and Callon (1992), innovation cannot take place without

the support of a global network, providing an adequate negotiation space. This study investigated current innovation practice in museums, by drawing on an analysis of data from two case-studies: The Viking Museum in Ribe (Denmark) and The Transport Museum in Coventry (England).

Our analysis suggests that museum innovation is being hindered by an unfavourable global network, imposing conflicting requirements in relation to the actual presence of a negotiation space and, on a more concrete level, regarding the imposition of traditional practices, creating a double bind situation, in which a clear direction to succeed is not provided (Bateson 1972). Therefore, innovation practices are being confined to safe innovation enclosures (like temporary or thematic exhibitions), coexisting with traditional practices, and a new professional identity for museums is struggling to emerge. Ideally a supporting global network might have promoted innovation enclosures into wakes of innovation (Boland et al. 2007), enabling museums to achieve innovation and a new organizational identity, which could suit well the professional value of museum practitioners .

In the next stage of our study, we intend to actively provoke innovation through the creation and evaluation of a new interactive artefact, aimed at facilitating learning and enhance communication between guides and children visiting museums. The new artefact will be tested in the two museums, with the children who participated to our participatory design process and with regular visitors. New insights are expected to emerge in relation to museum innovation and museum sociomaterial practices, from the perspective of both young visitors and museum practitioners.

7. References

1. Bateson, G. 1972. Steps to an ecology of mind. Jason Aronson Inc., Northvale New Jersey, London, Usa.
2. Boland, R. J.Jr. Lyytinen, K. and Yoo, Y. 2007. “Wakes of Innovation in project Networks: The Case of Digital 3-D Representations in Architecture, Engineering, and Construction”. Organization Science, Vol. 18, No. 4, INFORMS, pp. 631-647.
3. Bruid-Zeidman, L. and Schmitt-Pantel, P. 1989. La religion greque. Dans le cités à l'époque classique. Armand Colin, Paris, France.
4. Bødker, S. and Buur, J. 2002. “The Design Collaboratorium—a Place for Usability Design.” ACM Transactions on Computer-Human Interaction, Vol. 9, No. 2, June 2002, pp. 152–169.

5. Crowley, K. Jacobs, M. 2002. “Building Islands of Expertise in Everyday Family Activity”. G. Leinhardt, K. Crowley, & K. Knutson, Learning Conversations in Museums. Mahwah, NJ: Lawrence Erlbaum Associates, pp. 1-23.
6. Dindler, C. Iversen, O.S. 2009. “Motivation in the museum-mediating between everyday engagement and cultural heritage”. NORDES’09: Engaging Artefacts, Oslo, Norway.
7. Ewenstein, B. and Whyte, J. K. 2005. Knowledge Practices in Design: The Role of Visual Representations as 'epistemic objects'. EGOS 2005, Unlocking Organizations, 30 June – 3 July, Berlin, Germany.
8. Fallman, D. 2003. “Design-Oriented - Human Computer Interaction”. Proceedings CHI2003, Human Factors in Computing Systems, Fort Lauderdale, Florida.
9. Fleming, D. 2005. “Managing change in the museum”. Keynote address at The museum and change international conference 2005, National Museum Prague, Czech Republic.
10. Graham-Campbell, J. Valor, M. 2007. The Archaeology of Medieval Europe. Vol.1 The Eighth to Twelfth Centuries AD. Barnes and Noble, New York, USA.
11. Graves-Brown, P. M. 2002. Matter, Materiality and Modern Culture. Routledge, London, UK.
12. Hooper-Greenhill, E. Dodd, J.et al. 2004. “What did you learn at he museum today? The evaluation of the impact of the Renaissance in the Regions Education Programme in the three Phase 1 Hubs (August, September and October 2003)”. Research Centre for Museums and Galleries. Museums Library and Archive Council, London, UK.
13. Law, J. Callon, M. 1992. “The Life and Death of an Aircraft: A Network Analysis of Technical Change”. Shaping Technology/Building Society, ed. Bijke, W. E. and Law J. The MIT Press, Cambridge, Massachusetts, London, UK, pp. 21-52.
14. Marchetti, E. 2008. “Intertwining emergent interaction with a continuity of tradition”. The 2nd International Symposium on Systems Research in the Arts and Humanities, July 2008 Baden Baden, Germany, pp. 79-83.
15. Marchetti, E. 2011. “Story telling and Riddle Games. An ethnographic enquiry about museum guided tours”. Participatory Innovation Conference Pinc 2011, University of Southern Denmark, Sønderborg, Denmark.
16. Mazzone, E. Horton, M. Read, J. 2004. “Requirements for a Multimedia Museum Environment”. NordiCHI 2004, Tampere, Finland, pp. 421-424.

17. Orlikowski, W. J. 2007. “Sociomaterial Practices: Exploring Technology at work”. Organization Studies Vol. 28 No. 09, Sage Publications, Los Angelse, London, New Delhi, pp. 1435-1448.
18. Reeve, J. 2006. “Prioritizing Audience Groups”. The responsive museum, ed. Lang, C., Reeve, J. and Woollard, V., Ashgate, pp. 43-60.
19. Reeve, J. Woollard, V. 2006. “Influences on Museum Practice.” The responsive museum, ed. Lang, C., Reeve, J. and Woollard, V., Ashgate, pp. 211-222.
20. Pierroux, P. Kaptelinin, V. Et al. 2007. “MUSTEL: Framing the Design of Technology-Enhanced Learning Activities for Museum Visitors”. International Cultural Heritage Informatics Meeting (ICHIM 2007), J. Trant and D. Bearman (ed.), Toronto, Canada.
21. Star, S. L. Griesemer, J. R. 1989. “Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology 1907-39”. Social Studies of Science, Vol. 19, No. 3. SAGE, London, Newbury Park and New Delhi, pp. 387-420.
22.Woollard, V. 2006. “An Unsettled Profession”. The responsive museum, ed. Lang, C., Reeve, J. and Woollard, V., Ashgate, pp. 211-222.

Paper 2

Marchetti, E. and Petersson Brooks, E. 2012. "From Lecturing to Apprenticeship. Introducing play in museum learning practice." *Proceedings of eL&mL 2012: The Fourth International Conference on Mobile, Hybrid, and On-line Learning,* eds. Valerdi, J., Krämer, B., and White, S., January 30 – February 4, Valencia, Spain, International Academy, Research, and Industry Association (IARIA), pp.94-99.

From Lecturing to Apprenticeship

Introducing play in museum learning practice

Emanuela Marchetti
Department of Learning and Philosophy
Centre for Design, Learning and Innovation
Aalborg University Esbjerg
ema@create.aau.dk

Eva Petersson Brooks
Department of Architecture, Design & Media Technology
Centre for Design, Learning and Innovation
Aalborg University Esbjerg
ep@create.aau.dk

Abstract— **Analysis of museum learning practice, and related work, have revealed that communication of historical processes resembles school teaching, eventually hindering children's participation in museum learning activities. Starting from this issue, a new playful installation is being designed, actively involving a group of primary school children. Results from this process suggest that museum learning practice could be enriched, by moving toward a more non-formal learning approach, in which children and adults could engage in shared problem solving activities. Play is envisioned as an effective framework to support shared problem solving, also allowing for a symmetric dialogue to emerge between children and adults.**

Keywords-non-formal learning; historical process; apprenticeship; object-mediated interaction.

I. INTRODUCTION

Museums are currently facing a challenging innovation process, including re-shaping of, for example, their way of communicating historical and cultural knowledge to visitors. Many researchers have dealt with this challenge from different angles, from an institutional perspective [15] or from the visitors' perspective, either looking at what they do [6] or proposing new design solutions to enhance museum learning practices [14]. Despite these many contributions, these re-shaping processes are short off a clear direction toward innovation [15]. This situation has implications for museum learning practices, which still keeps a traditional and formal approach.

Conducting a Participatory Design (PD) study with a group of 25 Danish children around 10 years old, aimed at designing a playful installation to enhance museum-learning practice, a main issue was identified in the communication of historical processes. According to our study, museum practitioners consider guided activities as the most valuable learning method. Hence they tend to communicate historical processes through lectures, primarily in the form of one-way communication, based on chronological sequences of events, with the consequence of neglecting their actual complexity and embedded meaning.

Moreover, observations of primary school children attending a guided tour suggest that they perceive museum experience as another class to attend, in which the guide acts like a lecturing teacher as they walk through the exhibition space. As a result, the guided tour mainly elicits a form of static interaction mode, similar to traditional school lectures, in which children are supposed to listen quietly and raise their hands whenever adults ask them questions.

Therefore, starting from the data collected through the PD process, it is being suggested that museum learning practice could be enriched by introducing playful and shared problem solving activities, in which children could participate more actively in a form of apprenticeship [25]. Learning experiences concern active participation in activities, leading to knowledge and skills [25, 21]. In this way, the intention is to initiate and enhance a dynamic communication, in order to foster a symmetric dialogue between children and adults during guided museum tours. This, in turn, is supposed to allow for a more effective communication, including a richer understanding of the actual meaning of historical processes.

In the next section related work is presented, then, in section 3 research methods and an analysis of museum learning practice are discussed, focusing on the communication of historical processes. In section 4 the design outcome and implications for museum learning practice are presented, finally in section 5 conclusions and future works are discussed.

II. RELATED WORK

Different studies have been published in the past 20 years, about the use of interactive technologies in museums. The first solutions to be proposed were “kiosk-based computer exhibits” [14] showing audio and video material. Nowadays, more interactive interfaces have been created, promising a more engaging museum experience.

An interesting approach is represented by interactive environments, in which technology is hidden. Hence the visitors can simply interact with the exhibitions space and the objects available, focusing on the interaction itself, its output, and the exhibition content. The Kÿla installation follows this approach. Designed to enhance visitors' experience of an exhibition about archaic culture from Karelia, Finland, the installation is a dark exhibition space, where the visitors can look at old paintings, while walking through the space with a candle. Sensors are hidden close to the paintings, so that whenever the visitors approach a painting with the candle, an old Karelian music is played

 ISBN: 978-1-61208-180-9

[12]. Observations show that the installation elicits interest and emotional responses among the visitors. A similar setting is proposed by Hall and Bannon, exploring how ubiquitous computing could enhance children's experience of museums [8]. The setting has been tested in the Hunt Museum in Limerick, Ireland, dedicated to the memory of archaeologist John Hunt, who donated his collection to the people of Limerick. The exhibition is conceived as an RFID-based interactive space, in which children can interact with copies of the collection objects. For instance, they can leave their feedback about the exhibition, by talking to a phone and listen to others' activating a radio [8].

Multi-touch tabletop interfaces for museums seem to have a similar approach, in providing an interactive setting with a valuable affordance for social/playful interaction among the visitors [11], hiding the technology and enhancing content. These kinds of interfaces are often represented by interactive navigation systems, allowing visitors to access information in a different way, compared to traditional brochures or audio-guides. For example, “Tree Life Table” displayed at the Museum of Natural History in Berlin and “Kurio”, where the first installation is a multi-touch interactive surface, allowing visitors to search for information navigating through popping up bubbles, containing questions about different species. Ethnographic observations, conducted in the museum, reveal that people might engage in playful interaction, experimenting with what they could do with their hands, e.g. tapping with more than one finger at the same time, or caressing the surface with a flat hand [11]. Kurio [20] proposes a similar approach, but introducing play more explicitly, in the forms of shared problem solving, to enhance families’ museum experience. Kurio is a hybrid system including tangibles, a PDA, and a tabletop display. The visitors are invited to play the role of time travelers, stranded in the present time, who have to collect information about their current time, in order to go back to their own time.

Exploration of the domain of interactive technologies for museums is wide. These cases have been selected as they attempt to introduce playful interactions, to enhance learning in museums. Similarly, this study explores the possibility to use role-play and cooperation, as a way to acquire knowledge and experiencing historical dynamics.

III. MUSEUM LEARNING PRACTICE

A. Methods

This study is based on ethno-methodologies, such as participant observations, situated interviews, and participatory design (PD). Each session of field study and design process has been documented through video recordings and/or pictures, when possible, and field notes, to be available for qualitative analysis [26].

The project is conducted in cooperation with the Viking Museum in Ribe, in South-West Jutland (Denmark). This museum has been chosen because of its interest in communicating the story of the local community and its development. This form of complex historical processes is the focus of our study. The Viking Museum in Ribe is placed in the oldest town in Denmark, Ribe, which was originally a seasonal market place. In 700 King Godfred turned the market place into a permanent settlement, dividing the land into smaller lots, which could be rented or sold to merchants and craftsmen. Hence, Harald Bluetooth, in 900, developed Ribe into a town, mostly by having fortifications placed around the settlement it [7].

The story of Ribe represents a typical case of urban development, unfolded through an intertwining of sociomaterial practices, such as: production of goods, technical and economic innovation, and political decisions. The political aspect was expressed through manipulation of the territory, mainly in the form of infrastructures placement and maintenance, as discussed by Akrich [1].

Illustration 1: Free visit in Ribe.

A field study has been conducted, so to reconstruct museum experience from the perspective of all the “users” involved. Hence museum practitioners were interviewed and a group of 25 children around 10 years old were involved in a PD process, to gain an understanding of their values and dilemmas about museum learning practice. This particular target group was selected as they have already started to learn about history in school, they have probably visited several museums, and they are able to provide well-formulated accounts about their previous experiences.

The PD process was held at an after-school institution in Denmark, which became a *design collaboratorium* [5]: a space for co-design activities, where the prototypes could be stored for future investigations. In the beginning the children were interviewed about their previous experience of museums, supported by a few tasks. For instance, the children should write on a sheet of paper the museum they last visited and an adjective to describe how this visit was. Afterward their comments were shared in a joint conversation. Later the children were asked to comment upon pictures showing objects displayed in Ribe Museum. In the following session the children were invited to freely visit the museum, which offered opportunity to observe how they engaged, verbally and non-verbally, with the exhibition space (Ill.1). Finally the children were invited to co-design a game about the Viking Age and were provided with design materials: Lego bricks, modeling clay, colored pencils and

 ISBN: 978-1-61208-180-9

papers (Ill.2). All the participants in the co-design session engaged in a material brain storming, where ideas for the game were expressed through the creation of game pieces, which were tested and played with. Hence several artifacts were produced and, furthermore, a cardboard prototype was created and tested twice. Currently, a working prototype is under development to be tested in situ, at Ribe Museum (Table 1).

Table 1. Process Diagram.

PROCESS	
Winter-Spring 2012	**ANALYSIS** of data from test **THESIS WRITING**
Winter 2011-2012	**TEST** of hi-fi prototype at Ribe museum
Spring-Fall 2011	**DESIGN** development of hi-fi prototype
Winter-Spring 2011	**DESIGN** co-design and testing of low-fi prototypes with children
Fall-Winter 2010-2011	**FIELD STUDY** observations and interviews
Spring 2010	**SURVEY** on museums

Illustration 2: A participatory session.

B. Learning Practice and the Diachronic Perspective

Exhibitions have always been the main communication mode between museums and their public. Besides, publications, guided tours and other activities are offered to young visitors, so as to support them in gaining knowledge about the exhibition in question. The objects displayed, and the way they are being displayed, play a central role in museum learning practice, as this creates conditions for the ways learning, as well as social interaction, might emerge. The exhibition and the displayed objects constitute resources for communication enacting different functions:

- ideational (enacting "what goes on in the world");
- interpersonal (enacting relations between the visitors and between the visitors and the exhibition); and,
- textual (enacting the combined whole – the exhibition) [9].

Museum tours, guided or not, are a form of object-mediated interaction [10]. The exhibition is created to convey knowledge from the museum to the visitors, and for visitors to communicate with each other, verbally and non-verbally, through the exhibition space and the objects displayed [17].

Furthermore, despite that many tangible or interactive exhibition settings are being proposed by museums and researchers, a gap has been identified in relation to communication of history from a diachronic perspective, which deals with historical processes through time. It seems that such settings aim specifically, at providing an immersive experience, about how it might feel to be in a specific point in time, from a synchronic perspective. Somehow they represent an attempt to shorten the time distance between the past and the present. Interviews with museum practitioners reveal that tangible representations of the diachronic perspective are seen as an interesting possibility, but also as difficult to achieve. Instead, lecturing and story telling are seen as the most suitable communication mode, because of their sequential nature.

Generally, the only tangible representation of a diachronic perspective is the exhibition configuration, which starts with the oldest findings and ends with the most recent. Hence the museum tour acquires the shape of a walk through time. This is to say that complex historical processes, such as urban development, socio-cultural change, or technological innovation, most often are conveyed through lectures and written publications or, more briefly, through explicative signs. Our study suggests that this approach may have implications for learning and social interaction conditions, in the museum context. In this way, the real complexity of historical processes is hidden. By historical processes it is intended socio-material interaction among a group of people, within and through the natural environment and its affordances, as it emerges from historical [7] and anthropological studies [1, 13]. These processes embody sociopolitical thinking and have strong impact on emerging communities, so that they become part of their identity. Similar cases are discussed by Ingold [13], who specifically studies how humans relate to their environment, and Akrich [1], who discusses how infrastructures placement might embody complex political agendas, such as developing rural areas. The story of Ribe provides an interesting case of such dynamics, as urban development took place through socio-material actions, such as land partition into lots, development of the market place, and construction of defensive walls.

A tacit awareness about this kind of dynamics would be beneficial for young visitors' understanding of history, as well as for their social and cultural identity formation. Therefore, it was decided that the design outcome, from the present study, should aim at supporting learning of urban development, through playful and tangible interaction.

 ISBN: 978-1-61208-180-9

C. Social interaction in museums: guided versus free tours

Observations conducted during our field study and related work, show that emergent interaction among children and adults in museum, may assume different forms.

According to our data, during free tours some children explore the exhibition space divided into small groups, looking and commenting what they see. They may also be quite active physically, while others prefer a quiet walk by themselves. Furthermore, studies conducted on families visiting museums, suggest that many children have already learnt a lot by themselves about a specific topic, before coming to the museum. These children tend to comment the exhibition with their parents, showing off what they know, often criticizing the written explanations provided by the museum as incomplete or even wrong [6].

Instead our field work reveals that guides see their job as telling a “nice” story, that could be informative but also engaging for the children. They also would like to actively involve the children in the story telling process. The guides have developed a few strategies for that purpose, such as: to compare past and present, or to ask the children questions about the displayed objects to keep their attention alive, or even they try to “look at what they are looking at”, so to dynamically shape the story according to the children’s interest [17]. However, it is hard to understand if these strategies are as effective as desired, only a few children in fact seem to respond as expected. Most of them remain silent, wondering around the exhibition in small groups. This may happen because guides are perceived as authorities giving a lecture, and not as more equal facilitators.

Considering the analyzed dynamics, it seems as guided tours facilitate a static form of interaction, while free visits seem to afford a more playful exploratory interaction style, allowing for individual needs to be expressed, such as: chat with friends or enjoy a bit of calm. However, guides’ notion of story telling seems worth to pursue. It may also benefit from introducing play and/or playfulness, which could provide a safe and relaxed atmosphere, for children and adults to communicate as peers. Therefore, we propose to enhance children's museum experience, by introducing forms of tangible play, as a communication mode: so to provide a playful-material grounding to understand the complexity of historical processes and to provide an informal environment, facilitating the emergence of a symmetric dialogue between adults and children [22].

The scenario proposed in this study, is that museum learning practice should become a form of sociomaterial participatory apprenticeship. According to Rogoff [25] apprenticeship is a learning practice, in which individuals and their social partners are engaged in situated activities together, as an organic unit within the activity [25].

IV. MICRO-CULTURE

A. Design concept

A playful interactive installation has being conceived through the PD process, in the form of low-fidelity prototypes. It is intended for the children to experience, through play, the meaning of historical processes as sociomaterial interactions, specifically in relation to urban development and placement of infrastructures on the territory. The installation is called *Micro-Culture* to suggest a biological metaphor, in which the children are supposed to observe cultural phenomena in act, as biologists do with bacterial culture. Hence the children are expected to get a clearer picture of the dynamics behind urban development and of the implications of placing infrastructures, on land and people's everyday practices.

The game is designed as a mixed reality tangible installation, in which sociomateriality in play is being emphasized. In this way, children's attention should be focused on the learning content and the game. Furthermore, since social interaction and participation, in experiencing historical processes, is the central element of the game, the setting is intended to facilitate eye contact among the players, eventually resembling a mixed reality board game. Ideally the players should engage with an interactive surface projected on the floor. In this way, there would be no chairs and the playing surface could be wide enough, to afford free participation from anyone. Moreover, physical engagement should emerge without fear of breaking anything. But for practical reasons, a screen will be used for the test, placed horizontally on the floor. On the screen a simulation of a population and a landscape is being showed from above.

Illustration 3: Test of the low-fidelity prototype.

The population includes people at different ages in lifespan; they can be newly born, move around to different environments, grow up and have children of their own, and, then, grow old and die. This lifespan aspect allows to make the population more realistic and to take advantage of children's interest for human bones, and their instinctive sympathy for stories about people from the past [18]. Moreover, since we are dealing with a diachronic

 ISBN: 978-1-61208-180-9

perspective, the succession of generations, coming and leaving the world one after the other, can be used to provide a representation of time passing by. After a few generations, it should be possible to decide that an age is over and, consequently, move to another time. Hence the people could build different houses, wear different clothes, and behave differently.

B. Learning process

The design of Micro-Culture is motivated by the intention to enrich museum learning practice, so to transform it into a participatory apprenticeship. According to Rogoff, children acquire knowledge and skills, by being involved in goal directed activities, together with adults and/or peers, who act as guides through the learning process [25]. Rogoff's main references in this respect are Vygotsky [29] and Lenont'ev [16], who consider children as "active participant in their understanding", while engaged in "shared problem solving" together with their guides. Social interaction is considered to be essential for learning to happen, where adult or peer guidance is necessary in supporting the child to reach the "zone of proximal development", the region of sensitivity where the support from adults and/or peers is required for the child to reach beyond his or her limits [28, 29]. The prototype may act as a mediating resource, facilitating learning and social interaction [21].

The depicted situation has a few similarities with museum learning practice, as children are supposed to learn by coming to museum exhibitions and being guided by adult experts. Play and a playful approach offer a promising framework, when it comes to introduce shared problem solving within a given game. Furthermore, this could leverage on the guides' values, providing play as a communication mode for collaborative story telling. A goal could be directly embedded in the narrative, so as to facilitate individual play, for instance in trying to create a lively village or socially, in stealing peasants from each other.

Therefore, in our studies, play and playfulness may provide a valuable framework to introduce a goal-directed shared problem solving activity, enhancing children's participation in learning and social activities. Play is associated with exploration [24, 27]. Exploration occurs in novel situations where the child asks, "what can this object do?" whereas play occurs in familiar situations where the child asks, "What can I do with this object?"; situations where expressions and actions are experienced as sensations [22]. Accordingly, play consists of a variety of activities that involve manipulation of the environment. Bundy [3], Petersson [21], and Brooks and Petersson [2], have described play as a transaction between the individual and the environment, which creates situations that are intrinsically motivated, internally controlled, and free of constraints of an objective reality. According to cognitive developmental theories play is a cognitive process and a voluntary activity and as such it contributes to cognitive development, problem solving and creative thought. Furthermore, play develops innovation, flexibility, enhanced problem solving and adaptation [28, 30]. Socio-cultural theories of play emphasize that through play with others, children learn social rules and norms; aspects that are practiced through play [19]. In this study, we address play not just as an activity, but as a state of mind; a playful attitude, and we apply Bundy's [4] Model of Playfulness where playfulness is determined by: the *presence of intrinsic motivation*; the *internal control*; the *freedom to suspend reality*; and *social play cues*.

Initial testing with a low-fidelity prototype showed that, by playing, children could engage in a friendly dialogue with the researchers. Specifically, they started asking questions about the prototype and the purpose of the tangibles. Hence, while engaging into role play or in setting up their village, they often commented or asked us suggestions about what could be added or changed. Moreover, questions were raised by the children about how people died and how they lived in the past. They also asked playful questions, both during design and testing sessions, e.g. they asked if there were lions or snakes in Viking Denmark. This behavior might be facilitated by the different features of the prototype and game play. A board games-like configuration of the prototype and exchange of tangibles facilitated eye contact and social interaction among the players. Moreover, the absence of a set of specific rules, allowed the children to feel relaxed and to explore what they wanted to do without any fear for failure, for example by building a settlement or attacking and teasing each other, as they were rival land lords[1].

Certainly children's relaxed behavior may also be related to the fact that they became acquainted with us through a one year long PD process. Therefore, a working prototype needs to be tested in the museum, to verify if the same relaxed interaction style can emerge, also between the children and a guide they have never met. Moreover, a test should be performed also with occasional visitors, taking part to a guided or a free tour.

V. CONCLUSION AND FUTURE WORK

Starting from data collected during a one year participatory study and related work about museum learning practice, addressed to primary school children, this study discusses open issues regarding learning and social interaction in museums.

The main issue identified in our study is the use of conveying notions related to historical processes through lecturing. In this way children's museum experience resembles a lot school teaching, hence children are usually very quiet and it is not clear what they are learning. Moreover, the real complexity of historical processes may be hidden behind nominal sequences of facts.

A PD process has been conducted for one year involving children 8-10 years old; in order to design a playful setting that could support such learning practice. The outcome of the process is Micro-Culture, a playful installation, based on

1 A detailed discussion about emerging forms of play will be provided in a future publication.

 ISBN: 978-1-61208-180-9

tangible interaction and augmented-reality, aimed at conveying historical processes through play, emphasizing their meaning and complexity.

This study proposes to enhance learning in museums, by introducing play, so as to move from lecturing to apprenticeship, as defined by Rogoff [25f2]. The proposed approach intends to enrich story-telling practices, already present in museums, through play. Hence children and adults could both cooperate in creating their story, by playing together.

Initial testing seems to reveal that children could engage in play and informal dialogues with the researchers. More testing is needed in the museum, so to evaluate if and how playful interaction could be elicited between children and guides and what would be the learning implications.

REFERENCES

[1] M. Akrich, "The De-Scription of Technical Objects", in Shaping Technology/Building Society, studies in sociotechnical change, Bijker and Law, Eds. MIT Press, 1992 pp.205-224.

[2] A. Brooks and E. Petersson, "Play Therapy Utilizing the Sony EyeToy®", Presence 2005, London, UK, 2005 pp. 303-314.

[3] A. Bundy, "Measuring Play Performance", in M. Law, D. Baum and W. Dunn (Eds.). Measuring Occupational Performance Supporting Best Practice in Occupational Therapy, 89-102. NJ: Slack Inc., 2001.

[4] A. Bundy, "Play and Playfulness: What to Look for", In L.D. Parham and L.S. Fazio, Eds. Play in Occupational Therapy for Children, St. Louis, MO: Mosby, pp. 52-66, 1997.

[5] S. Bødker and J. Buur, "The Design Collaboratorium – A Place for Usability Design", in ACM Transactions on Computer-Human Interaction, Vol. 9, No. 2, June 2002, pp. 152–169, 2002.

[6] K. Crowley and M. Jacobs, "Building Islands of Expertise in Everyday Family Activity", in Learning Conversations in Museums, G. Leinhardt, K. Crowley, & K. Knutson, Eds. Mahwah, NJ., Lawrence Erlbaum Associates, 2002.

[7] J. Graham-Campbell and M. Valor, "The archaeology of Medieval Europe , vol. 1, eighth to twelfth century AD," Aarhus University Press, 2007.

[8] T. Hall and L. Bannon, "Cooperative design of children's interaction in museums: a case study in the Hunt Museum", in CoDesign, vol. 1, n. 3, pp. 187-218, 2005.

[9] M. A. K. Halliday, "An Introduction to Functional Grammar", London, Edward Arnold, 1985.

[10] A. Henare, M. Holbraad and S. Westel, "Thinking through Things, Theorising artefacts ethnographically", Routledge, 2007.

[11] E. Hornecker, "I don't understand it either, but it is cool" – Visitor Interactions with a Multi-Touch Table in a Museum", in Proceedings IEEE Tabletop 2008, pp.121-128, 2008.

[12] T.Ilmonen, "Tranquil interaction: exploring archaic culture in the Kÿla installation", in Proceedings of the 2007 conference on Designing pleasurable products and interfaces, 22 August, Helsinki, Finland, pp. 92-106, 2007.

[13] T. Ingold, "The perception of the Environment, Essays in livelihood, dwelling and skill", Routledge, 2000.

[14] J. Kidd, I. Ntala, and W. Lyons, "Multi-touch interfaces in museum spaces: reporting preliminary findings on the nature of interaction," in Re-thinking Technology in Museums: Emerging Experiences, Ciolfi, Scott and Barbieri, Eds. University of Limerick, 2011.

[15] C. Lang, J. Reeve and V. Woollard, "The responsive museum: working with audiences in the twenty-first century", Ashgate 2006.

[16] A. N.Leont'ev, "The problem of activity in psychology", in The concept of activity in Soviet psychology, Wertsch, Ed. Armonk, NY Sharpe, 1981.

[17] E. Marchetti, "Story Telling and Riddle Games" in Proceedings of Pinc 2011, Participatory Innovation Conference, Sønderborg, Denmark, 13-15 January 2011.

[18] E. Marchetti, "Myth and Bones: Museums Socio-epistemic practice and children's values", in Proceedings of InterSymp'2011, The International Institute for Advanced Studies in Systems Research and Cybernetics, IIAS 2011, 1st Symposium and Panel on The Art of Relational Living in the Communication Age, 1-5 August 2011, Baden-Baden, Germany, 2011.

[19] G. H. Mead, "Mind, Self, and Society", Chicago, IL: University of Chicago Press, 1934.

[20] K. Muise and R. Wakkary, "Bridging Designers' Intentions to Outcomes with Constructivism", in Proceedings of the 8th ACM Conference Design of Interactive Systems, Aarhus, Denmark, 2010.

[21] E. Petersson, "Non-formal Learning through Ludic Engagement with in Interactive Environments", Doctoral dissertation, Malmö University, School of Teacher Education, Studies in Educational Sciences, 2006.

[22] E. Petersson and A. Brooks, "Virtual and Physical Toys: Open-Ended Features for Non-Formal Learning", CyberPsychology & Behavior, 9:2, pp. 196-199, 2006.

[23] E. Petersson and A. Brooks, "Non-formal Therapy and Learning Potentials through Human Gesture Synchronized to Robotic Gesture [HRI] within a Virtual Environment [VE]", Universal Access in the Information Society, 6:166-177, 2007.

[24] A. L. Robinson, "Play the arena for acquisition of rules for competent behavior" American Journal of Occupational Therapy, vol. 31, pp.248-253, 1977.

[25] B.Rogoff, "Apprenticeship in Thinking, Cognitive Development in Social Context", Oxford University Press, 1990.

[26] D. Silverman, "Doing Qualitative Research", Sage, 2005.

[27] B. Sutton-Smith, "The role of Play in Cognitive Development", in Young Children, pp. 361-369, 1967.

[28] L. S. Vygotsky, "Play and its role in the mental development of the child". *Voprosy Psikhologii*, 12, pp. 62-76, 1966.

[29] L. S. Vygotsky, "Mind in society: The development of higher psychological processes", Cambridge, MA, Harvard University Press, 1978.

[30] L. S. Vygotsky, "Thought and Language*"*, Massachusetts: The MIT Press, 1997.

 ISBN: 978-1-61208-180-9

Paper 3

Marchetti, E. and Petersson Brooks, E. 2012. "Playfulness and Openness: Reflections on the Design of Learning Technologies." *Arts and Technology. Lecture Notes of the Institute of Computer Sciences, Social Informatics and Communication Engineering (LNICST)*, ed. Brooks, A. L., Springer Publishing Company, 101, 2012, pp. 38-45.

Playfulness and Openness: Reflections on the Design of Learning Technologies

Emanuela Marchetti and Eva Petersson Brooks

Centre for Design, Learning and Innovation
Department of Learning and Philosophy
Department of Architecture, Design, and Media Technology
Aalborg University
Niels Borhs Vej 8, 6700, Esbjerg, Denmark
{ema,ep}@create.aau.dk

Abstract. What does it mean to design a playful learning tool? What is needed for a learning tool to be perceived by potential users as playful? These questions emerged reflecting on a Participatory Design process aimed at enhancing museum-learning practice from the perspective of primary school children. Different forms of emergent interactions were evident, both during museum visits and while testing a low-fidelity prototype. Deeper reflections on the meaning of enhancing learning through play from a user's individual perspective was assessed. In this respect, openness and multimodality were evaluated intertwined with design of playful learning tools to enrich non-formal learning and to allow support for individual needs.

Keywords: non-formal learning, playfulness, open-ended design, multimodality, emergent interaction, learning technologies.

1 Introduction

Museums are currently facing a challenging innovation process, including a re-shaping of their role as learning practices. Related work has dealt with this challenge from different angles; from an institutional perspective [1] or from the visitors' perspective considering new design solutions to enhance museum as learning practices [2]. According to our study, mono-directional forms of communication of historical processes during guided tours still appear unexplored. These forms of transferring knowledge result in static interactions between children and adults, and to superficial understanding of abstract historical concepts. Primary school children (age 10) experience museums as an "adults-mediated" activity, in which adults are in control and where children and museum guides do not talk much to each other. The children are often depicted as a pleasant audience, as their behaviour is generally polite, somehow influenced by their school training. Therefore, a Participatory Design (PD) study has been conducted with a group of children (age 10), in order to investigate how museum-learning practice could be enhanced from the children's perspective.

A.L. Brooks (Ed.): ArtsIT 2011, LNICST 101, pp. 38–45, 2012.

The aim of the PD process was to develop a new playful learning tool, involving a group of 10 years old children as co-designers. Observations conducted during visits in the museum and co-design workshops revealed how children may have different individual needs, in relation to play and to experiencing the museum. Some children tend to prefer more social situations, in which they can talk, laugh and eventually be physically active together with others. Others may choose quiet and solitary experiences, to enjoy by themselves or just together with a few friends.

Based on these findings, a reflection was conducted in relation to what makes a learning tool playful and engaging, from the individual perspective of the learners and their individual needs. It is argued that playfulness should be intended as an intertwining of openness and multimodality, to facilitate different user experiences.

2 Related Work

The field of technologies related to learning and more specifically to the museum context has become incredibly wide. However, some main tendencies can be identified and considered for inspirations when it comes to designing new technologies for museums. The first technological solutions for museums were interactive kiosks showing video audio media about the museum exhibition [2].

Generally, technologies proposed for museum contexts focus on providing visitors with interactive alternative access to information. The aim of this research is to provide visitors with an exciting museum experience, to allow them to learn more about the exhibition, to have fun during their visit, and to motivate them to come again. Many researchers have specifically focused on young audiences (children and teenagers), proposing computer-augmented installations to make their museum experience more fun [3, 4, 5]. Some of these works simply intend to leverage on young people's interest for computer games [4, 5], while others refer more or less explicitly to Prensky's theory about digital natives [3]. According to Prensky [6] young people have been deeply affected by continuous exposure to digital media since a very young age, and accordingly, developed different preferences regarding learning and fun. For example, they prefer a learning-by-doing approach to reading and education, and "random access" to information instead of being guided step by step by adults [6]. Based on these considerations, Prensky proposes a "computer-based" approach to learning, in which young learners may acquire knowledge by playing a computer game [6].

Researchers active in the field of developing technologies generally follow the same approach. Studies such as [3] explicitly refer to Prensky as a source of inspiration in their attempt to bridge teenagers' everyday interests with museums to elicit in them a motivation to visit museums. In order to achieve their goal, Dindler and his colleagues ran a series of participatory workshops which allowed them to find out that in some cases teenagers were not interest to the past itself, but it could be made more interesting by constructing parallels between the past and their own everyday [3]. Other researchers in the same field do not explicitly refer to such theories, but still seem to adopt digital technologies to add elements of fun and play. In the case of the Life Tree interactive table, at the Museum of Natural History in Berlin the researchers intended to provide a more engaging access to information about the different species displayed in the museum [4]. The result is an interactive multi-touch surface; a series of popping-up

bubbles allows the users to navigate among different information. Tests conducted in the museum revealed that people developed playful gesture interactions, as they experimented how to touch the surface, for instance by tapping with one or more fingers simultaneously, or even with flat hands [4].

A study conducted by Hall and Bannon [5] about ubiquitous computing within museum space, refers specifically to primary school children and proposes to hide technology to focus on interaction in itself. A new setting was created for the Hunt Museum in Limerick, through a participatory process and tested during an exhibition. An interactive environment was proposed in which children could interact with RFID-augmented copies of the collection items. In this way, they could leave their feedback about the exhibition by talking to a phone and listen to others' activating a radio [5]. Finally, systems such as Kurio introduce play more explicitly, intended as a way to support learning by doing and social interaction [5]. Kurio was designed to enrich families' museum tours, introducing a form of shared-problem solving activity. Families are supposed to pretend they are time travelers, stranded in a different time, and gather information about the current time to be able to come back [7]. Interestingly, this system seems to transform museum tour into a sort of apprenticeship, in which children and adults cooperate together in shared problem solving activities [8].

These works are inspiring and provide new directions to museum innovation. However, a gap was identified in the fact that such works do not discuss guided tours, which are the most common modality for children when they visit museums. Moreover, such approaches, as well as the installations provided by museums, aim at providing an immersive sensorial impressions of the past from a synchronic perspective, neglecting somehow the diachronic perspective, dealing with historical processes. Hence, issues related to guided tours practice and the diachronic perspective constitute the main focus of this study.

3 Methods and Background

The context for our research is *Ribes Vikinger*, the Viking Museum in Ribe, in Southwestern Jutland, Denmark. This museum was chosen because it has a mission in spreading knowledge related to local history to a wide audience, moreover, it displays a small but precious collection of artifacts, dated more or less from Prehistory to the Renaissance, with a special emphasis to Viking and Middle Ages.

In order to gain more meaningful and child-centred knowledge, a Participatory Design process was organized with an after school institution, involving a group of 25 children (10 years of age), in designing a playful learning tool for museums. Several activities have been conducted within the PD process; the children were interviewed about their previous museum experience and asked to carry out a few tasks, such as writing the name of the last museum they visited and detail an adjective to describe it. Furthermore, they should comment on pictures showing artifacts displayed in Ribe. The children were also invited to visit the museum; data collected during this visit were analyzed qualitatively and compared with data from observations conducted during a guided tour with a group of pupils (age 10). Afterwards the children participated in four co-design workshops, in which they had to design and test low-fidelity prototypes of the game. During such workshops and museum visits, individual

needs were identified in relation to play and museum experience, which constituted a framework for the reflections presented in this study.

4 Emergent Play and Museum Experience. Design of Micro-Culture and Observational Data

The aim of this study was to investigate how to transpose complex historical processes, specifically urban development through time, into playful interactions, to enhance learning and engagement in museums. Special attention was dedicated to guided tours, as they represent the typical way children experience museum. Moreover, board games, objects-mediated form of play, seemed to offer an interesting framework to enhance social interaction and to provide an experiential/tangible grounding to historical processes. Games such as Monopoly or Risk provided interesting sources of inspiration. Board games practice is a form of social interaction mediated by material objects [9], in which players engage in a peer, face to face, based communication. Moreover, the players often start a theatrical improvisation, staging the game situation and teasing each other, as it was all for real [10]. The material configuration of the games seems to play a central role in eliciting this particular interaction, as the board is placed at a lower level than the players' gaze, defining a circular interaction space with the players sitting around it. Hence players are supposed to place tangibles on the board and in some cases, like in Monopoly, to exchange them with each other. In this way the game play has a natural affordance for eye contact and social interaction, as the players look at each other through the game, then while acting on the tangibles they enter into a closer contact and in that moment a particular form of emergent interaction may occur as the players start staging the game situation [10].

This social dynamics match communication of historical processes, allowing the players to experience how a certain process may unfold through time and what would be the implications for the people involved. However, board games have usually a complicated system of rules that must be learnt before starting to play. Our game intended to be more unstructured and leverage on material affordance of a gaming board and tangibles.

The outcome of this process is *Micro-Culture*, a mixed reality setting composed by a tabletop surface, showing a simulated territory consisting of a population and a set of tangibles, representing infrastructures to be placed on the territory, such as bridges or streets. The Micro-Culture game is based on a biological metaphor with experiments and observations of bacterial cultures. A low-fidelity prototype has been developed and tested twice; a working prototype is currently under development.

The technical set up includes a webcam and a computer. The game is implemented in Python and with ReacTIVision, a system including a set of markers and software to develop tangible interfaces[1]. The markers are placed on Micro-Culture tangibles, so that they can be traced and recognize by a webcam and through the software. In this

[1] http://reactivision.sourceforge.net/

way, the simulation and population can be programmed to respond to the tangibles and provide direct feedback to players' actions. For instance, if a player places a bridge on a river, the bridge will appear in the simulation and people may start crossing it.

However, interviews, observations in museums and testing of a low-fidelity prototype showed that children had individual needs to express themselves, both in relation to the museum experience and related to play and playing. Comparisons between observations conducted with a group attending a guided tour and with the group of co-designers during a free tour, revealed different forms of emergent interaction. During the guided tour the children were very quiet, they tended to split into small subgroups, some followed more constantly the guide while others, usually on the back of the main group, moved around and whispered to each other. Other children did not seem to be part of a specific group, but looked at things by themselves. Children participating to the free tour manifested similar tendencies: some actively explored the exhibition space, chatting lively and almost running. Other children preferred a more quiet fruition of the space, walking quietly, talking and laughing at each other, at times even asking questions to us. Finally some children liked to be alone, for example, a girl liked to sit by herself in a niche and when she was asked if she liked the museum, she mentioned that she especially liked the space because "it is silent and I can be alone with my thoughts" (Figure 1).

Testing with the prototype showed a similar differentiation. Some children set up their "settlement" by placing a few tangibles and then started to play as expected; they interpreted the setting as a board game or a role-play game platform. Hence they acted as they were "landlords", competing with each other to conquer the other player's land. They also introduced tanks, a float, and soldiers as new tangibles for the game. Especially girls, considered the game as a design tool, which meant that they spent most of their time in creating their own settlements and in making new tangibles, specifically shops for the market place, animals and farms, ships. Afterward some children from the designer group started to play with the "landlords" group and seemed to enjoy a war-like game (Figure 2).

Fig. 1. Solitary and social museum experience

An interesting interplay emerged when this mixed group of players agreed that they wanted to play the game together. However, one designer girl expressed the desire to have everything ready before playing and she spent a lot of time in settling everything up with another girl. The landlord group asked repeatedly if they were ready and even took initiative attacking their piece of land so that they could play. The designer girl did not appreciate this and she stated: "Stop, I am not ready yet!"

Fig. 2. Emergent play: designing and engaging

Despite the small size of the cardboard board the children managed to arrange different groups playing differently. Interestingly, the mixed group and some individuals expressed forms of so called playful play, defined by Sutton-Smith [11] as a particular form of play in which creative players may define rules for others' play. This happened during the game a few times. The mixed group created tangibles and dynamics related to the tangibles for their play. Two female designers spent their time in making tangibles and playing dynamics related to such tangibles, and then they placed them on the board for the others to play with. Moreover, during a co-design workshop, a girl created a whole narrative framework, in which the player had to go through a quest, in the end a fight with Kraken should have taken place, and if the player survived then he/she would be able to access the Valhalla, otherwise he/she would die and be buried in a cemetery.

Considering these different forms of interaction expressed by the children, a concern emerged in terms of defining the meaning of designing a playful learning tool. In other words, what would be the characteristic of a learning tool to be perceived as playful by different individuals?

5 Playfulness, Openness and Multimodality

Reflections conducted on observational data from Participatory Design and museum visits informed that certain play dynamics might not be appealing for all learners.

Furthermore, considering the communication mode used to convey meanings related to historical processes, it seems as they primarily are based on a verbal mode of communication. This may happen because of the sequential nature of historical processes, as confirmed by interviews conducted with museum practitioners. We propose more tangible and playful communication modes to support understanding of historical processes.

The creation of a playful tool promotes a deeper investigation about how to enrich the current interaction style. Playful and fun experiences were targeted. This means that the children were engaged through different choices of action. The choice in how to do things was in this case closely related to having fun [12, 13, 14]. In this way, the learning tool provided a basis for evolution of playful experiences where the children could find their own ways for interacting.

In this sense it is being claimed that a playful learning tool should be characterized by openness, in the sense that its material affordance should easily support different forms of emergent interaction. This challenge requires multiple opportunities for manipulation and forms of play integrated in an open-ended model for learning [15].

To achieve such openness, the concept of multimodality appears as closely interconnected benefiting from the insight that children have different orientations to modes, specific preferences for temporal or spatial, image or speech, bodily movement [16, 17]. Multimodality combines these different modes providing a framework allowing different forms of sensorial explorations and openness in the form of extended forms and choice of interaction mode.

The board game configuration, Micro-Culture, facilitated social and object-mediated interaction. The absence of specific rules, which are typical in board games, allowed the children to decide for themselves, they could decide to engage with others in cooperative play but also to create some space for themselves and their imaginary world, or even to shift from one modality to another. The relatively small size of the board seemed not to hinder the co-existence of subgroups and their play dynamics. However, it may have created a few issues, for instance social players tended to occupy most of the space, while solitary players were using very little areas of the board. Probably a larger surface, such as a projection on the floor, may have provided a better affordance.

Social interaction is supported basically by hiding the technology and by coupling input and output, players' actions and the simulation responses, on the same playing surface, so that the system is not disrupting players' attention from establishing eye-contact and from the learning content. Audio effects could support tangible interaction and visual animated simulations in order to make the whole simulation even richer and more engaging.

6 Conclusion and Future Work

This study presented reflections about the meaning and implication of designing learning related technologies. The discussion is based on data collected during a one year Participatory Design process, aimed at exploring ways to enhance museum-learning practice from the perspective of primary school children. A group of 25 children, 10 years old, were involved in designing a new learning technology, aimed at enriching learning of historical processes and also social interaction between children and their guides when attending museum tours.

Reflecting on related work and data from the study, we propose a perspective in which playfulness regarding learning related technology should fit individual values of play. During our PD process it was noticed that children expressed distinctive individual needs regarding museum experience and play. Hence our original project was re-shaped to create space for users' needs. In this sense, playfulness is interpreted as strictly interrelated to openness and multimodality, to provide support for richer and more self-driven interaction forms.

References

1. Lang, C., Reeve, J., Woollard, V.: The responsive museum: working with audiences in the twenty-first century, Ashgate (2006)
2. Kidd, J., Ntala, I., Lyons, W.: Multi-touch Interfaces in Museum Spaces: Reporting Preliminary Findings on the Nature of Interaction. In: Ciolfi, Scott, Barbieri (eds.) Rethinking Technology in Museums: Emerging Experiences. University of Limerick (2011)

3. Dindler, C., Iversen, O., Smith, R., Veerasawmy, R.: Participatory design at the museum: inquiring into children's everyday engagement in cultural heritage. In: Proceedings of the 22nd Conference of the Computer-Human Interaction Special Interest Group of Australia on Computer-Human Interaction, OZCHI 2010, Brisbane, Australia (2010)
4. Hornecker, E.: I don't understand it, but it is cool – Visitor Interaction with a Multi-Touch Table in Museum. In: Proceedings of IEEE Tabletop (2008)
5. Hall, T., Bannon, L.: Cooperative design of children's interaction in museums: a case study in the Hunt Museum. CoDesign 1(3), 187–218 (2005)
6. Prensky, M.: Digital Natives, Digital Immigrants. On the Horizon 9(5) (2001)
7. Muise, K., Wakkary, R.: Bridging Designers' Intentions to Outcomes with Constructivism. In: Proceedings of the 8th ACM Conference Design of Interactive Systems, Aarhus, Denmark (2010)
8. Rogoff, B.: Apprenticeship in Thinking. Cognitive Development in Social Context. Oxford University Press (1990)
9. Henare, A., Holbraad, M., Westel, S.: Thinking through Things, Theorising artefacts ethnographically. Routledge (2007)
10. Marchetti, E.: Evocative Objects and Fun. A study about board games practice as objects-mediated social interaction. In: CRESC Conference 2009, Objects – What's Matters? Technology Value and Social Change. University of Manchester (2009)
11. Sutton-Smith, B.: The Ambiguity of Play. Harvard University Press (1997)
12. Göncü, A. (ed.): Children's Engagement in the World. Sociocultural Perspectives. Cambridge University Press, New York (1999)
13. Rogoff, B.: Becoming a Cooperative Parent in a parent Cooperative. In: Rogoff, B., Goodman Turkanis, C., Bartlett, L. (eds.) Learning Together. Oxford University Press, New York (2001)
14. Petersson, E.: Non-formal Learning through Ludic Engagement within Interactive Environments. Doctoral dissertation, Malmö University, School of Teacher Education, Studies in Educational Sciences (2006)
15. Petersson, E., Brooks, A.: Virtual and Physical Toys: Open-ended Features for Non-formal Learning. Cyber Psychology and Behavior 9(2), 196–199 (2006)
16. Kress, G.: Multimodality. A Social Semiotic Approach to Contemporary Communication. Routledge, London (2010)
17. van Leeuwen, T.: Introducing Social Semiotics. Routledge, London (2005)

Paper 4

Marchetti, E. 2013. "Playful learning culture in the museum. MicroCulture and Guided Tour Practice." *Teaching and Learning Culture. Negotiating the Context*, eds. Kirkebaek, M. J., Du, X., and Jensen, A. A., October 11 2013, Sense Publisher, Rotterdam, The Netherlands, pp. 129-144.

EMANUELA MARCHETTI

9. PLAYFUL LEARNING CULTURE IN THE MUSEUM

MicroCulture and Guided Tour Practice

INTRODUCTION

In recent years, museum learning culture and practice have become a matter of debate in response to a crisis within the museum sector, which has caused pressure from external organizations which are demanding that museums become more effective at managing their resources, attracting more visitors, and providing evidence regarding the relevance of their practices to society (Janes, 2009). As a result, museum innovation has become a common research topic across many different disciplines. Surprisingly, only a few studies have been dedicated to the practice of guided tours which represent a typical learning practice and often serve as children's first museum experience (Best, 2012).

Museum learning culture is dominated by two competing positions, the *modernist* and the *postmodern* (Dysthe et al., 2012), which correspond to the *contextualist* and the *formalist* positions (Pierroux, 2010). These two positions have opposite values regarding learning outcomes and the relationship between learners and guides. The modernist and contextualist positions aim at passing the same knowledge to all the visitors, while multiple learning outcomes are appreciated in the formalist and postmodern positions. In addition to these two positions, two main discourses seem to emerge in museum studies: a *macro-level discourse* dealing with the identity of the museum and its relevance to society (Dysthe et al., 2012; Lang et al., 2006), and a *micro-level discourse* dealing more specifically with daily learning practice and its impact on visitors, and the design and introduction of digital technologies (Muise & Wakkary, 2010; Hornecker, 2008).

Using these insights as a starting point, a qualitative study has been conducted in cooperation with two historical museums, namely The Transport Museum in Coventry, England, and The Viking Museum in Ribe, Denmark. The premises of this study are that culture is a changing process and that culture is created through the encounter of different individuals in accordance with the complex concept of culture (Jensen, 2007; Kirkebæk, chapter 2 in this volume). The study aimed at gaining a comprehensive understanding of museum learning culture, focusing on guided tours and historical discourse, and on contributing to the innovation of these practices through the design of a new digital learning platform. A participatory design process was therefore undertaken in cooperation with the Danish museum

M. J. Kirkebæk et al. (Eds.), Teaching and Learning Culture: Negotiating the Context, 129–144.

and a local afterschool facility. A group of 25 children of approximately 10 years of age was actively involved in designing a digital game set in the Viking Age. Based on the theories of Rogoff (1990) and Vygotsky (1978), a digital, table-top game called *MicroCulture* was created with the goal of setting up the conditions for playful learning in museums, eliciting a sociocultural awareness of history, and creating the opportunity for an enriching encounter between the children and the museum guides.

RELATED WORK: FRAMING MUSEUM LEARNING CULTURE

Many studies have been conducted on the process of museum innovation, mainly taking two complementary perspectives: a macro-level discourse concerned with the role of the museum as a cultural organization and learning context within society (Lang et al., 2006), and a micro-level discourse concerned with what happens inside the museum. Furthermore, museums can been viewed from a sociocultural perspective, dealing with the role of guides and educators (Best, 2012; Ritchhart, 2007), or a visitors' perspective, concerning the digitalization of museum practice (Muise & Wakkary, 2010; Hornecker & Stifter, 2006). A few studies attempt to provide a holistic discourse, linking the macro and micro levels so that the role of the museum within society is discussed through specific cases (Dysthe et al., 2012; Hooper-Greenhill et al.; 2004), but they do not explicitly mention the two perspectives.

Several researchers use different terminology when discussing museum learning culture in reference to learning and guided tours. Dysthe et al. (2012), for instance, talk about a paradigmatic change, and Pierroux (2010) introduces the term "narratives" or "positions". However, despite the different terms used in the literature, two main positions emerge as dominant, the first being concerned with assessment and in passing on "true" knowledge to each visitor, and the second being concerned with eliciting a constructive dialogue between guides and visitors, and acknowledges individual learning outcomes as valuable. These two positions answer to the descriptive and the complex concepts of culture, respectively (Jensen, 2007; chapter 2 in this volume). These two concepts have strong implications for learning practice. The descriptive concept focuses on the role of teachers in passing on knowledge, implying a teacher-centered, lecture-based approach to teaching. Meanwhile, the complex concept implies a student-centered and task-based approach to teaching, emphasizing constructive dialogue and the making of meaning (Baeten et al., 2010; Kirkebæk, chapter 2 in this volume).

According to Pierroux (2010), museum learning culture is dominated by two opposite positions, or "narratives": the formalist position, represented by the Museum of Modern Art (MoMA) of New York, and the contextualist position, represented by Philadelphia Museum of Art. The formalist position emphasizes interpretation and is based upon the pedagogical method of Visual Thinking, according to which inexperienced visitors should be helped to develop their perceptual and reasoning

skills through intuitive thinking. As a consequence, the formalist position values the emergence of individual and differentiated learning outcomes. The contextualist position, however, is concerned with assessment of learning and disciplinary context so as to avoid the emergence of misunderstanding and false knowledge. In this sense, the contextualist position admits the existence of a true knowledge to be passed on to each visitor. According to Pierroux (2010), who conducted a comparative study in order to establish how the two positions are embedded in art education and how they affect learning and interaction, it was discovered that similar strategies emerged among educators at both MOMA and the Philadelphia Museum of Arts. In both museums, the guides asked the visitors to describe the displayed objects, then reformulated students' responses and connected previous utterances together while discussing a specific matter. Furthermore, expressions of ownership and multiple interpretations emerged in both contexts, through negotiations, agreements, and disagreements. But, in the end, the formalist position appears more receptive to supporting interpretive analyses of artworks; the educators do not focus their talks exclusively on the objects and the students are supposed to contribute to the interpretive discourse (Pierroux, 2010). The formalist position seems to approach museum artifacts as boundary objects, in the terms of Star and Griesemer (1987). The objects displayed in museums are seen as providing trading zones through which guides and visitors can establish a mutual understanding, negotiating and sharing their individual understandings, which are rooted in their individual backgrounds and interests. In this way, the guided tour is seen as a dialogic practice of sense-making, mediated through physical artifacts.

According to Dysthe et al. (2012), these two opposite positions represent a paradigmatic change in which museums are moving from the modernist to the postmodern position. Modernist museums aim at revealing true knowledge about the past, possibly to prevent misunderstandings in the visitors. Conversely, postmodern museums strive to engage in dialogue with visitors. On a general level, it is possible to argue that the contextualist position embodies values from the modernist culture, while the formalist position embodies values from the postmodern culture. According to Dysthe et al. (2012), this paradigmatic change toward the postmodern museum is needed within the context of contemporary multi-ethnic societies composed of individuals with different backgrounds and experiences. The postmodern position acknowledges that sense-making and understanding cannot be separated from the individual cultural background of the visitors, promotes an open attitude towards learning and culture and supports both the integration of young people into society and their involvement in active citizenship (Dysthe et al., 2012).

The fostering of active citizenship among young people is also acknowledged by Hooper-Greenhill et al. (2004) as a main contribution of the museum to society from a macro-level perspective. Hooper-Greenhill et al. discuss a quantitative evaluation of an initiative called the Renaissance in the Regions Education Programme from the perspective of primary school pupils and teachers. This initiative is aimed at creating an integrated network of local museums by grouping them into regional hubs so as to enrich museum learning culture. Based on the data gathered, the report

argues that museums are "achieving government targets" in fostering confidence and motivation in primary school children (Hooper-Greenhill et al., 2004).

However, despite many studies having been conducted on museum practice and culture, only a few are devoted to the guided tours that are a central component of museum learning culture. Therefore, what really happens during guided tours and how this practice contributes to the education of young people, or how it may be improved in order to do so more efficiently, is still a matter to be investigated in-depth (Best, 2012).

A similar paradox holds in relation to design studies which propose engaging digital solutions aimed at enriching visitors' experience. However, such studies tend not to link their digital solutions to current museum practice and the needs of guides and curators. It is argued in this paper that the lack of integration between the proposed digital solutions and the needs of museum practitioners may hinder the process of museum innovation and slow down the introduction of digital technologies. Two studies stand out (Muise & Wakkary, 2010; Hornecker & Stifter, 2006); although they do not take into account the needs of the museum and the practice of guided tour, they do discuss digital installations in relation to visitors' current practices, providing general guidelines for the design of new learning technologies.

The study conducted by Hornecker and Stifter (2006) discusses results from a complex quantitative study, investigating the quality of visitors' interaction when engaging with the digital installations displayed at the medien.welten exhibition held by the Museum of Sciences in Vienna, Austria. The aim of the exhibition was to raise awareness regarding a contemporary, media-based society in different age groups. The visitors were invited to engage with thematic islands that displayed installations focusing on advancements in the areas of transmission, storage, and calculation media, in chronological order. Through ethnographic observations, Hornecker and Stifter were able to establish general patterns regarding visitors' needs and habits. For example, it was noticed that visitors expressed emotional responses towards objects from their everyday life, with older visitors showing a nostalgic feeling for the objects they used when they were young. The exhibit also allowed visitors to engage with the installations in different ways, making it possible for some to dedicate more time to specific installations, while others spent a little time at each installation in order to experience the whole exhibition. This means that digital installations should be enjoyable in both short and long periods of time, according to visitors' needs. Finally, while many visitors came to the museum in groups, most exhibitions are designed for individuals. As a result, installations involving problem-solving activities and providing support for social and tangible interaction appeared to be the most successful since the visitors spent the most time engaging with them.

The study conducted by Muise and Wakkary (2010) proposes a new learning scenario targeted at families' tours via the design of a digital hybrid system called Kurio. The visitors are supposed to play the role of time travelers who are stranded in another time and have to repair their time compass in order to return to the proper time. The system involves several devices: a set of tangibles, a table-top display,

and a personal digital assistant (PDA). The proposed learning scenario is based on constructivism, with references to the works of Piaget (1896–1980) and Vygotsky (1896–1980). Following constructivism, Muise and Wakkary introduce forms of playful problem solving in the museum in order to enrich families' experience.

Taking these insights into account, this study proposes the introduction of forms of tangible play in order to enrich the practice of the guided tour with respect to promoting historical discourse and social interaction between guides and primary school children.

GUIDED TOURS AND DISCOURSE IN HISTORICAL MUSEUMS

The empirical study was conducted over a period of one year and involved two main sites: The Viking Museum in Ribe, Denmark, and The Transport Museum in Coventry, England. Since the present study is concerned with the richness of guided tour practice and the quality of the interaction emerging between visitors and guides, the choice was made to use qualitative methods, such as ethnographic and participant observations as well as situated and semi-structured interviews (Pink, 2007). A participatory design process was conducted in the Danish context, involving a group of 25 children ranging from 9 to 12 years old from a local afterschool institution. This target group was selected primarily because children in this age group have tried guided tours with their school classes, and also because the guides define them as "nice" visitors, although they are often not very communicative, making it difficult for the guides to assess if they are learning anything or if they have particular interests.

The design process (Fig. 9.1) was carried out in a participatory fashion in order to actively involve the children as co-designers (Druin, 2002). The children were

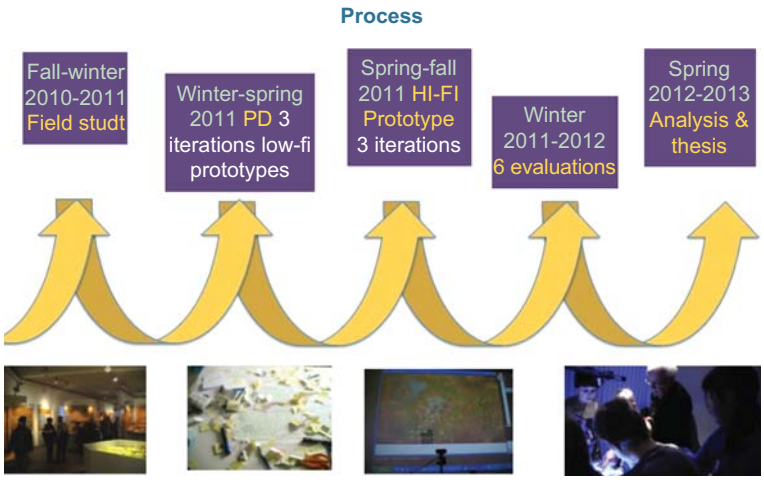

Figure 9.1. Design process.

invited to take part in a total of six workshops. The first two workshops were task-based interviews, aimed at gathering insights about children's museum experience; the first was carried out in the children's afterschool facility and the second inside The Viking Museum. During the four following workshops, the children were asked to cooperate with the researcher to design tangibles for a game about the Viking Age. Different materials were presented to the children, including play dough, Lego bricks, and drawing materials. During the final two workshops, a low-fidelity cardboard prototype of a table-top game was presented to the children, who were supposed to play and modify it according to their taste by mainly using sticky notes, markers, and other drawing materials.

A total of seven versions of the concept were realized and tested through the process. The resulting working prototype was tested six times, with the first three tests being preliminary evaluations with the curator, the pedagogue from the afterschool institution, and two guides from Ribe. Finally, the last three tests were conducted with three different groups of seven to eight children inside the museum so that the participants could be observed interacting with MicroCulture during a real guided tour.

Each session involving the users was video-recorded and analyzed through the interaction analysis method (Jordan & Henderson, 1994). This means that the analysis took into account the richness of emergent interaction, looking at not only verbal language, especially in relation to how it referred to play and history at the same time, but also modulation of the voice, gestures, and facial expressions. The focus of the analysis was to capture the quality of emergent interaction between children and guides, and, in relation to the final test with the working prototype, to evaluate how MicroCulture affects the practice of guided tours from the perspectives of both groups of participants.

Challenges in Museum Learning Practice

Results from the field study revealed a convergence between the two contexts with respect to emergent strategies and open issues, such as:

– The "mono-directional" nature of the communication between guides and visitors.
– Ineffective communication of historical processes.

Despite the many differences identified between the two museums, such as differing organization structures, division of labor, funding strategies, and sociocultural context, similar issues emerged. Personnel from both museums claim that a main issue in the museum learning culture is the "mono-directional" essence of the communication taking place between museums and the public. The same term was used by the curators of both sites, and by the head educator from Coventry. In both cases, a dialogue between society and museums is not emerging, and this is happening on a macro-level perspective as well as on a micro-level perspective between guides and visitors. As a result, curators are not sure of how to best innovate their practices

in such a way so as to ensure that the main exhibition is preserved despite their desire to enrich it. As said by the curator from Coventry: "We are having more visitors, but we are not sure what they like or what to change!"

Furthermore, from a micro-level perspective related to guided tours and the interaction emerging between guides and children, it seems as though museum learning culture embodies values from traditional, teacher-centered teaching; the guides take the role of teachers, acting as authority figures, and establish routines for the children, deciding which objects to pay attention to and for how long (Ritchhart, 2007). They perceive their activities as storytelling in the sense that they aim at telling the children a good story in order to elicit in them an interest in history and prompt them to search for new information, thereby becoming more aware of their own cultural identities. In this sense, their understanding of museum learning practice is in line with current studies, according to which the mission of museums is to promote a cultural awareness and active citizenship (Hooper-Greenhill et al., 2004; Dysthe et al., 2012).

In general, the guides seem satisfied with the way children respond to the guided tours; they are "nice" and "polite," and they seem to follow the guides. However, it has been noticed that children never ask the guides questions. A few of them speak, but only when they are first asked a question, such as being prompted to identify a specific object. This situation is confirmed by observations of guided tours and makes it difficult for the guides by limiting their ability to assess if the children are learning anything, if they need support, or if they have a particular interest in specific artifacts.

Results from the workshops with the children show that children initially have positive feelings when talking about their museum experiences, describing museums as "interesting," "nice," and "fun." However, historical museums are not the first that come to mind; most children were referring to The Fisheries Museum in Esbjerg, an aquarium where children can look at different varieties of fishes and aquatic animals. Moreover, when talking specifically about historical museums, a few children complained that although they liked the Vikings, Nordic myths, and war stories, they found some museums to be "boring" since "you cannot touch anything" or "run." According to data gathered through this study, children have strong emotional responses to living beings, possibly explaining the attraction to the Fisheries Museum, where the children can see the fish moving, watch the seals performing exciting tricks, and touch skates coming out of water to interact with the children. Inside The Viking Museum, however, the children relate emotionally to stories about children of their own age who lived in different historical periods, and to the skeletons displayed in the museum. This phenomenon is interpreted as a form of emotional perception (Merleau-Ponty, 1948) in which the children approach people from the past by imagining the possible lives they could have lived.

Regarding the learning of history, it has been observed that the use of tangible installations is usually restricted to reconstructions of environments and artifacts, while historical processes are communicated mostly through verbal speech.

Moreover, in England, museum personnel feel pressure from the school system to conform to a linear, facts-based view of history. This issue emerged at numerous times during the interview with the curator and is discussed in literature as severely constraining museums' freedom to innovate (Reeve & Woollard, 2006). According to the head educator, local schools expect museums to present history as a sequence of events which is "easy to be discussed in class and fits what we already do!"

However, it is argued that the dominant use of verbal communication can be ineffective, as it may hide the complex intertwining of events and sociocultural factors determining historical processes. Moreover, this approach may prevent children from gaining an intuitive understanding of such processes and performing their own critical reflections, which are valuable because they can contribute to the goals envisioned for museum practice in current studies, such as the fostering of culture of thinking (Ritchhart, 2007) and participation in active citizenship, the latter of which flourishes through reflections on personal experiences (Dysthe et al., 2012).

A PLAYFUL LEARNING SCENARIO FOR MUSEUMS

Based on the insights gained from the field work, a new learning scenario was proposed, leveraging on mediated play as a resource for conceptual thinking and allowing children to gain an intuitive understanding of history as a complex sociocultural process.

The study conducted indicates that museum learning culture is still rooted in traditional learning approaches, in which guides acquire the role of teachers and children the role of pupils; in this sense, when accessing the museum, children receive another lecture. However, in both museums used in the study, material objects, archeological findings, and reconstructions were found to enrich the children's learning and experience of the museum. Interestingly, it was noticed that all reconstructions focus on history from a synchronic perspective, in which history is seen as a series of points in time (Fig. 9.2). These installations include walk-through setups, such as reconstructions of a Viking ship or of streets during World War II. These installations are appreciated because they offer multimodal engagement, allowing visitors to interact in personal ways and stimulating different sensorial spheres (Kress, 2010). Moreover, these installations create an illusion of coevalness (Fabian, 1983), in which the distance in time between the past and the present is reduced.

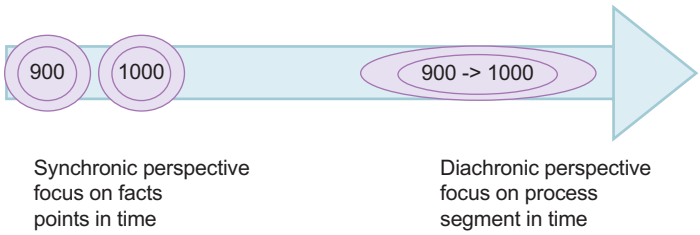

Figure 9.2. Synchronic versus diachronic perspective.

Conversely, when it comes to the diachronic perspective of history, or dealing with processes through time, verbal communication is the dominant communication mode; no visual or tangible representation is given. According to the diachronic perspective, history is seen as a complex intertwining of events in which individual actions are affected by social forces, producing unexpected and unintended outcomes (Carr, 2001).

It is argued in this study that the sequential nature of verbal language is not adequate for providing an accurate representation of the complexity of historical processes due to the risk of communicating history as a series of disconnected events that occurred in sequential order. It is also argued that the current trend in museum learning culture should be enriched, shifting from a lecturing framework toward one of a playful apprenticeship in thinking (Marchetti & Petersson Brooks, 2012; Rogoff, 1990). Therefore, a new learning scenario is proposed in which guides and children start their interaction by playing together with interactive representations of historical processes, the different elements of which are mirrored in the representation itself and build on the participants' playful interactions. This new learning scenario is based upon the theories of Rogoff (1990) and her framework of apprenticeship in thinking and Vygotsky's (1978) theory of play. According to Rogoff, children learn new knowledge and skills by engaging in goal-directed activities together with expert adults. The role of the adults is vital to the children's learning, as they communicate the correct course of action through their interaction with the physical context. Moreover, adults support children by segmenting the activity into smaller tasks that fit within the children's potential, so as to help them when reaching their zone of proximal development (Rogoff 1990, Vygotsky, 1978), which represents the boundary between what they know and what they can learn according to their cognitive development. In this sense, the situation defined by Rogoff is close to what takes place during guided tours, in which children are supported by expert adults who disclose to them the knowledge embodied in the artifacts displayed in the museums.

Moreover, according to Vygotsky (1978), play with physical toys is a vital factor to the development of superior mental functions. Much like when children engage with physical toys, they project their actions into an imaginary world in which they can freely explore various courses of actions and their implications. In this way, children learn to move from the plane of "now and here," or their current physical contexts, and to think on an abstract, conceptual level.

Finally, both Rogoff and Vygotsky claim that learners should actively participate in their learning. Evidence gathered through the empirical study suggests that active participation is currently lacking in museum learning culture even though it could offer a significant contribution to the emergence of active citizenship. Play is, therefore, envisioned as a resource to:

– Create multimodal representations of historical processes.
– Support children to become more active and reflective in their learning.

– Provide a tool for the guides to better communicate on the topic of historical processes.

Therefore, this study proposes a shift from lecturing toward a playful learning culture so as to contribute to the museums' goals of fostering cultural awareness and active citizenship by stimulating their visitors' imaginations.

The Design of MicroCulture

The outcome of the design process was MicroCulture, and its creation is based upon all the insights gathered throughout the empirical study. The name comes from a metaphoric understanding of guided tours, in which culture is the focus of learning and participants conduct shared "experiments" over a simulated "culture."

The result is a table-top tangible game aimed at representing urban development as a sociocultural process resulting from the interplay between political authorities, their actions of placing infrastructures over the territory, and the peasants' responses. This topic was selected as it represents a complex historical process and is relevant to both museums.

Different technical settings were considered for MicroCulture; ultimately, a hybrid platform was created based on off-the-shelf technologies such as a flat screen TV, a high-definition web-cam, and a dual-core processor laptop (Fig. 9.3). A basic set of four paper tangibles was provided, shaped as bottomless cubes, each representing a different infrastructure of the kinds that were used in Ribe during the Viking Age: a wooden-paved street, a wooden bridge, market place fences, and a circular turf rampart like those King Harald Bluetooth placed around Ribe when it became a town (Jensen, 1991). Four sets of tangibles were provided to the participants in the final tests so that there would be enough tangibles for all the children and the guide.

The TV screen shows a simulation of a settlement with a population, implemented in Python, specifically using the Pygame game library and ReacTIVision (Keltenbrunner & Bencina, 2007), an open-source tracking system created to support the development of tangible interfaces. The system can save a screenshot every 30 seconds (Fig. 4) in order to support analysis of the interaction during the

Figure 9.3. MicroCulture during the final evaluation and screenshot.

testing by comparing the children's actions during their play with the result of their actions as captured in the screenshots.

In order to play, the participants are supposed to place the paper tangibles on the screen. The system can tolerate multiple tangibles simultaneously while still using the webcam to trace the unique marker placed on the top of each tangible. After a few seconds, the players can remove the tangibles and an infrastructure will appear on the simulated settlement. The simulation is inspired by games such as *Simcity*, *Civilization*, *World of Warcraft*, and the board game *Monopoly*, the latter of which was chosen for the tangible face-to-face interaction that it affords. Ultimately, MicroCulture is conceived as a computer simulation, showing a village and its population from a top-down perspective, as seen in *Simcity*, *Civilization*, and *World of Warcraft.* The interaction style, however, is inspired by *Monopoly*, a board game allowing players to engage in a tangible, face-to-face interaction.

All of the graphics are hand-drawn in a non-photorealistic style and inspired by the artifacts the children made during the design process. The simulation attempts to reproduce the dynamics of infrastructure placement, focusing on the way this affects the territory and the freedom of action of each of the characters forming the populations. For instance, when a player places a bridge tangible on the map, a bridge appears in the simulation and enables the characters to cross a river, reaching the opposite bank. In this way, the players can build new houses and new workshops in areas that were not formerly reachable, expanding their settlement. Similarly, streets convert woods or swamps into a planked walkway on which the characters can walk and establish new houses and workshops. Hence, infrastructure placement directly affects the life of the characters, as they become able to extend the range of their circulation and actions, overcoming natural constraints. Each infrastructure disappears after a while, meaning that landowners have to be committed to their land, using resources to keep the infrastructures in a functional state and replacing them when needed.

Finally, the characters are given a simulated life cycle, so that they are born as females and males within a household and then move out of their parents' home to establish their own home some distance away when they grow old. In this way, the simulation reproduces the dynamics of Jutland wandering villages[1], the center of which migrated with new generations (Schmidt, 1991).

DISCUSSION

Results from the final tests show that forms of mediated tangible play can support children in reflecting on historical concepts at an abstract level by reasoning on their play.

A rich interaction unfolded between children and guides, progressing through four main stages in which the children explored different forms of play and different aspects of the simulation:

1. Technical
2. Collaborative play

3. Role-play
4. Competitive play

This progression started with an introductory phase, in which the presence of a game elicited enthusiasm and curiosity in the children, prompting them to ask many questions in order to understand how the system worked, how they could play with it, and what they were allowed to do. This response is interpreted as a form of emotional perception (Merleau-Ponty, 1948) in the sense that the children were confronted with a familiar object and with the possibility to play inside a museum. Similar responses were identified also by Hornecker and Stifter (2006) in relation to how children responded to the presence of games in the *medien.welten* exhibition. The first group of participants had the strongest response; they expressed their emotional state verbally and through facial expressions. They said that the game was "cool!" or "nice" while smiling. Their reaction was probably caused by a feeling of ownership as they recognized that it was the game we designed together; a boy even asked: "Is it the game we made? With the play dough and paper?" and then added "Ahhh, cool!" The other two groups also showed enthusiasm, but in a moderate way; however, all the groups played for approximately 20 minutes and complained when it was time for them to continue with the tour.

Generally, after having played approximately 5–10 minutes, the three groups moved toward a stage in which they focused on the simulation content; it was in this stage that the guides were able to use MicroCulture to talk about history with the children. The children's attention was focused on the dynamics of the simulation, which mirrored historical dynamics of infrastructure placement, and this was expressed by the children's talking with the guides. The children tended to associate themselves with one of the five islands represented in the simulation map (Fig. 3), expressing forms of collaborative play, which evolved into role-play. Typical utterances were, for example: "*We* need more streets on *our* market place!" or "*We* need to place a bridge for *our* people." Through this stage, the children reasoned about how to connect different areas on the simulation, how to support the circulation of the characters (peasants) over the territory, and how to prevent swamps from appearing again. For instance, a girl directly asked the guide if the swamps could "disappear," and, in another case, a discussion emerged on the role of bridges in connecting market place areas:

> Boy: "Should there be another market place there?"
>
> Guide: "There should be a street and the street should be connected to a bridge!" (Mixed voices)
>
> Boy: "Where is a bridge?" (Looking around for the tangible)
>
> Guide: "What about these people there? How could they make it to the marketplace?" The boy places a bridge where the guide is pointing.
>
> Girl: "There should also be this!" (a street). She passes the street-tangible to the boy.

This form of interaction may look simple, but it embodies meaning, pointing at archaeology of landscape and practical use of infrastructures from the perspective of peasants moving in a natural environment.

Most children reached a stage of collaborative role-play in which they exchanged and passed tangibles to each other as in the reported conversations. It was only in the case of the first group that a form of competitive play was identified, in which the children challenged each other as if they were competing landowners. A girl placed a series of ramparts in order to eliminate riverbank access to an influx of peasants coming from the island of a boy playing close to her. She addressed the boy, laughing and saying, "Caught! J. You are caught!" The boy answered "Nooo!" and then responded to the attack by placing a series of bridges, allowing his peasants to cross anyway. This interaction is particularly interesting, as it shows that the children gained an understanding of the functional role of infrastructure in warfare through play.

This progression into stages is marked by the gradual emergence of fantasy and role-play in which children "hallucinate," imagining that the situation depicted in their play is real (Sutton-Smith, 1997). As the children got more and more immersed in the fantasy play, the guided tour became a theatrical reenactment in which historical processes were reproduced through a participatory storytelling, allowing for shared sense-making and active involvement of the participants. This means that mediated play can allow guided tours to shift from a teacher-centered paradigm to one that is more student-centered (Baeten et al., 2010; Kirkebæk, chapter 2 in this volume), promoting active participation of learners as recommended by Rogoff (1990) and Vygotsky (1978). Moreover, through fantasy play, the children mirrored the personal and interpersonal dynamics involved and their effects on the community plane, in urban development as a sociocultural activity (Rogoff, 1995) as they enacted how landlords could have behaved in relation to developing their territory, either cooperating or competing with each other. The simulation also showed how personal actions affected the settlements and the life of the peasants, linking the personal and interpersonal planes to the societal plane (Rogoff, 1995). In this way, MicroCulture represents sociocultural activities in their richness, displaying an intertwining of the different planes of focus and mapping them into the different dimensions of mediated play, these being the players' interactions, the tangibles, the different features in the simulation, and the individual behaviors of the players.

Implications

Data gathered through the study indicates that mediated play can contribute significantly to the practice of guided tours, enriching the interaction between children and guides from a micro level perspective and answering to Rogoff's (1995) personal and interpersonal planes. During the final test with MicroCulture, the guides were supportive in relation to children's play and their responses, and they also said that they were happy to answer to the children's questions. The guides

provided support in sense-making and participated in the children's fantasy play. In this sense, mediated play allows the participants in guided tours to achieve a different state of mind, engaging in a sort of theatrical act, in which reality can be turned upside down and usual hierarchical relationships subverted (Sutton-Smith, 1997). In Best's (2012) words, mediated play emphasizes and enriches the already existing improvisational nature of guided tours.

At the same time, digital simulations and mediated play correspond to the activity of conceptual thinking supported by physical toys as discussed by Vygotsky (1978), so that by being immersed in their "hallucination," children reflect upon the implications of their actions, asking "what if" questions within the framework of the game.

The results gained through the study also have implications for the macro-level perspective on museum innovation. Regarding children and their learning, the introduction of mediated play within guided tours can support museums changing from the modernist toward the postmodern cultural framework. Much like the formalist position (Pierroux, 2010), play allows for the emergence of individualized interpretations of knowledge through the free exploration of meaning. In this sense, mediated play could be envisioned as a communicative and representational resource in the postmodern museum.

Furthermore, introduction of mediated play within museum learning culture embodies consequences for the role of guide. In fact, it implies that the guided tour has to be perceived as an open-ended learning practice in which multiple learning outcomes are acknowledged. Moreover, guides have to be aware of their role in sense-making in relation to discussing parallels between the past and the present, which could contribute to the emergence of cultural awareness in young visitors. During observations of guided tours in both museums, parallels between the past and the present were explicitly discussed, in relation to specific objects, such as a smooth bone that was used as a skating blade during the Viking Age. However, this did not happen during the final tests; the attention of the guides seemed absorbed in the simulation and in assisting the children, even though they could have taken the opportunity to discuss parallels between the past and the present with regard to the use of communication infrastructures. Therefore, the introduction of mediated play within guided tours implies that guides have to be trained differently in order to be able to use the available technology to its full potential.

Such insights should be taken into consideration within the debate that has emerged in the UK about the professionalization of guides or educators[2]. The profession of the museum educators is, in fact, defined as an "unsettled" profession (Woollard, 2006) because a precise education path is not required to access it. Moreover, educators seem to be marginalized inside the museum, so that not involved in important decision-making processes. This marginalization could be related to the fact that educators are in direct contact with visitors; they are the ones dealing with "the children" (Woollard, 2006). However, by being in touch with visitors in the context of a postmodern museum, guides are in the privileged position of interacting with visitors in person and thereby participating in their sense-making process. As a

result, they are the only professionals to gain firsthand information on the visitors' needs, which means that their opinions should be taken into serious consideration regarding exhibition planning, which technologies the museum should purchase, and how new technologies should be used.

CONCLUSION

This chapter has discussed a participatory, design-oriented study about how mediated play could support the process of innovating museum learning culture. Two main issues are taken into account: the emergence of a monodirectional communication between guides and children during guided tours, a common practice with surprisingly little study devoted to it; and the frequently ineffective communication of historical processes.

A cross-cultural study has been conducted in Denmark and England, comparing how this change is taking place in two historical museums. Moreover, a participatory design process has been conducted in the Danish context, involving approximately 25 children of roughly 10 years of age. A new learning platform, called MicroCulture, was created, based on the evidence gathered, the theories of apprenticeship in thinking (Rogoff, 1990), and play as a learning resource for conceptual thinking (Vygotsky, 1978).

Results from the final evaluation of MicroCulture show that mediated play can significantly contribute to the innovation of current museum learning culture, offering rich implications for both the macro and micro-level discourses emerging in museum studies. On a micro-level perspective, mediated play provides the children with space for self-expression and a meaningful grounding for critical thinking about historical knowledge while giving the guides a way to assess the children's needs. Moreover, on a macro-level perspective, introduction of mediated play can contribute to the fostering of active citizenship in the children, emphasizing individual interpretation, active participation in learning, and cultural awareness. Finally, mediated play could introduce a new professional recognition of the role of guides and educators within museums, requiring a re-conceptualization of their training so that they will be better prepared to employ digital technology and play as a pedagogical tool.

NOTES

[1] These particular settlements were found in Southern Jutland, close to the area of Ribe, where the museum is placed.

[2] The term "educators" consistently appears in Anglo-Saxon literature.

REFERENCES

Baeten, M., Kundt, E., Struyven, K., & Dochy, F. (2010). Using student-centred learning environments to stimulate deep approaches to learning: Factors encouraging or discouraging their effectiveness. *Educational Research Review*, *3*(5), 244–260.

Best, K. (2012). Making museums tours better: understanding what a guided tour really is and what a guided tour really does. *Museum Management and Curatorship*, *27*(2), 35–52.

Druin, A. (1999). Cooperative inquiry: Developing new technologies for children with children. *Proceedings of CHI'99*, May 15–20 1999 (pp. 592–599), Pittsburgh, USA.

Dysthe, O., Bernhardt, N., & Esbjørn, L. (2012). *Dialogbaseret Undervisning. Kunstmuseet som læringsrum.* Skolestjenesten: Copenhagen, Denmark.

Hooper-Greenhill, E., Dodd, J., Phillips, M., O' Riain, H., Jones, C., & Woodward, J. (2004). *What did you learn at the museum today? The evaluation of the impact of the Renaissance in the Regions Education Programme in the three Phase 1 Hubs (August*, *September and October 2003)*. Research Centre for Museums and Galleries. Museums Library and Archive Council, London, UK.

Hornecker, E., & Stifter, M. (2006). Learning from interactive museum installations about interaction design for public settings. *OZCHI 2006*, Sydney, Australia.

Janes, R. (2009). *Museums in a troubled world: Renewal*, *irrelevance*, *or collapse?* Routledge, London, UK.

Jensen, S. (1991). *Ribes vikinger*. Den Antikvarisk Samling i Ribe, Ribe, Denmark.

Jensen, I. (2007). *Introduction to cultural understanding*. Frederiksberg: Roskilde University Press.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *Journal of the Learning Sciences*, *4*(1), 39–103.

Kaltenbrunner, M., & Bencina, R. (2007). reacTIVision: A computer-vision framework for table-based tangible interaction. *Proceedings of TEI 2007 The first international conference on tangible and embedded interaction*, ACM.

Lang, C., Reeve J., & Woollard, V. (2006). *The responsive museum: Woes rking with audiencof the twenty-first century.* Ashgate Pub Co, Aldershot.

Marchetti, E., & Petersson, E. (2012). From lecturing to apprenticeship: Introducing play in museum learning practice. *The fourth international conference on mobile*, *hybrid*, *and on-line learning* (pp. 94–99). *IARIA*, Valencia, Spain.

Merleau-Ponty, M. (1948). *The world of perception.* First edition 1948, first translation 2004 published by Routledge, New York. 2004.

Muise, K., & Wakkary, R. (2010). Bridging designers' Intentions to outcomes with constructivism. *Proceedings of the 8th ACM conference design of interactive systems*, Aarhus, Denmark.

Pierroux, P. (2010). Guiding meaning on guided tours. In Morrison A. Chapter (Ed.), *Inside Multimodal composition*, *14*, 417–450.

Pink, S. (2007). *Doing visual ethnography.* Sage, London.

Reeve, J., & Woollard, V. (2006). Influences on museum practice. In C. Lang, J. Reeve & V. Woollard (Eds.), *The responsive museum* (pp. 211–222). Ashgate.

Ritchhart, R. (2007). Cultivating a culture of thinking in museum. *The Journal of Museum Education. Critical Thinking Skills in the Museum*, *32*(2), 137–153.

Rogoff, B. (1990). Apprenticeship in thinking. *Cognitive development in social context*. Oxford University Press, New York.

Rogoff, B. (1995). Observing sociocultural activity on three planes: Participatory appropriation, guided participation, and apprenticeship. In J. Wertsch, P. Del Rio & A. Alvarez (Eds.), *Sociocultural studies of mind* (pp. 139–164). Cambridge University Press, Cambridge, New York.

Schmidt, H. (1994). *Building custom in Viking age Denmark*. Aarhus University Press, Aarhus, Denmark.

Star, S. L., & Griesemer, J. R. (1989). Institutional ecology, 'translations' and boundary objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology 1907–39. *Social Studies of Science*, *19*(3), 387–420. Sage, London, Newbury Park and New Delhi.

Sutton-Smith, B. (1997). *The ambiguity of play*. Harvard University Press, Boston.

Vygotsky, L. S. (1978). *Mind in society. The development of higher psychological processes*. Harvard University Press, Cambridge Massachusetts, London England.

Wertsch, J. V. (1978). Adult-child interaction and the roots of metacognition. *Quarterly Newsletter of the Institute for Comparative Human Development*, *2*, 15–18.

Woollard, V. (2006). An unsettled Profession. In C. Lang, J. Reeve & V. Woollard (Eds.), *The responsive museum* (pp. 221–222). Ashgate, Aldershot.

Paper 5

Marchetti, E. and Valente, A. 2013. "Diachronic Perspective and Interaction: New Directions for Innovation in Historical Museums." *The Technology Collection. International Journal of Technology, Knowledge and Society,* 8 (6), 2012-2013, Common Ground Publisher, pp. 131-143.

Diachronic Perspective and Interaction: New Directions for Innovation in Historical Museums

Emanuela Marchetti, Aalborg University, Denmark
Andrea Valente, Aalborg University, Denmark

Abstract: Although researchers have proposed many engaging digital solutions to enhance museum learning practice, most museums prefer to stick to low-tech settings. Our study suggests that technologies are not broadly adopted because a clear vision, about their role within the troubled process of museum innovation, is missing. Therefore, starting from the design of a new learning platform for museums, we propose a new scenario, so to show concretely how digital technologies, and their specific affordances, could contribute to museum innovation. This scenario is envisioned with respect to two main levels of discussion: a micro level dealing with everyday practice inside the museum, and a macro level regarding museums external relations, within the local community and society in general.

Keywords: Museums, Cultural Capital, Digital Technologies, Social Interaction

Introduction

Innovation of museum practice is currently a hot topic and different solutions have been proposed or analysed (Dysthe et al. 2012, Muise and Wakkary 2011). According to several researchers, technologies are increasingly present in museum practice (Kidd et al. 2011, Hornecker and Stifter 2008), yet our study suggests that technologies are far from being absorbed into museum common practice, especially in small and medium size ones, because a long-term vision seems to be missing, regarding relevance of digital technologies for the innovation process.

The lack of vision for technological innovation in museums is confirmed by data collected during the *MicroCulture* project (Marchetti and Petersson Brooks 2012), which was conducted in cooperation with The Viking Museum in Ribe (Denmark) and the Transport Museum in Coventry (UK). The design outcome of MicroCulture is a multi-player mixed-reality tabletop game, installed and tested in Ribe. According to our data, museum practitioners prefer to stick to low-tech settings, which are perceived as (almost) equally engaging, less disruptive, cheaper, and simpler to maintain.

Moreover, it is hard to gain an exhaustive picture of the museum innovation process as a whole, as two parallel levels of discussion are emerging in museum related studies: a situated level, dealing with visitors' experience during a specific exhibition (Hornecker 2008), in this study it is called *micro level*. Other studies instead discuss museum practices from an institutional perspective, focusing on their role within the whole society (Janes 2009), which in this study is called *macro level* (Fig. 1). Only a few studies propose an inclusive picture, driving conclusions from the visitors' situated perspective and the more general socio-cultural one; however, they do not address explicitly the two perspectives and the role digital technologies (Dysthe et al. 2012, Hooper-Greenhill et al. 2004).

With respect to the micro level, the MicroCulture project focused on how to enrich guided tours, so to allow children and guides to engage into a playful apprenticeship in thinking (Rogoff 1990), allowing children to gain an intuitive understanding of the socio-cultural meanings embodied in historical processes (Carr 2001) and to communicate with the guides as peers. As for the macro level, technologies are seen as flexible boundary objects (Star and Griesemer 1987), able to make current innovation practices agile and cooperative, through relations with external institutions. Museums could then become vital centres for the creation of cultural capital (Bourdieu 1986), from which society could benefit.

The International Journal of Technology, Knowledge and Society
Volume 9, 2012, techandsoc.com/, ISSN 1832-3669

Designing MicroCulture for a specific audience and stakeholders, we had the possibility to empirically test our assumptions regarding the advantages and acceptance of digital technologies. Reflecting and generalizing from the approach followed for MicroCulture, this paper discusses the benefits digital technologies can offer to museum innovation, at both micro and macro levels.

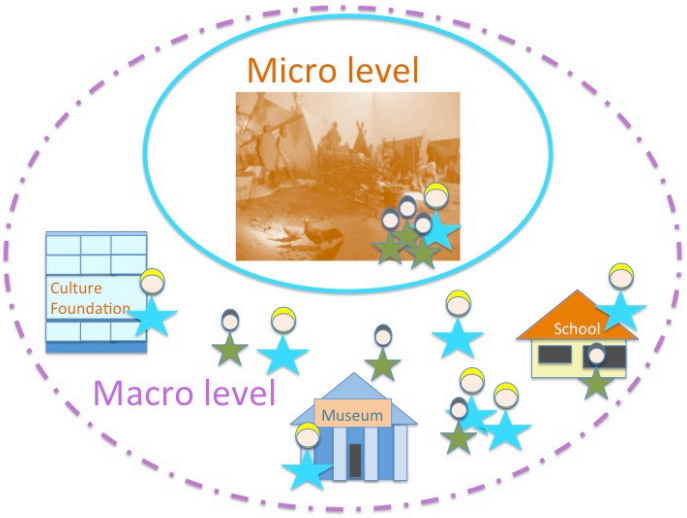

Figure 1. Macro and micro levels. The micro level circle deals with museum and individual visitors; the macro level circle represents instead the interrelationship between museums and other institutions.

In the next section we discuss related work in the field of interaction design for museums. In section 3 the MicroCulture and data from field work are discussed, then in section 4 we propose a unifying micro-macro level perspective about the role of digital technologies within museum practice. Finally in section 5 conclusions and future works are discussed.

Related Work

According to several researchers digital technologies are becoming increasingly popular in museums (Kidd et al. 2011, Hornecker 2008), and new solutions are being proposed, supported by insightful case studies, such as Muise and Wakkary (2011) or Dindler and Iversen (2009). In general these studies aim at introducing alternative ways to seek information and playful forms of interactions. For instance, Dindler and Iversen (2009) propose to introduce digital technologies, so to bridge young visitors' everyday interests and their museum experience. The authors base their work on Prensky's (2003) "digital natives" theories, claiming that through early use of computers, young people have developed different ways of learning. For instance, computer game players learn to access information individually and not through step-by-step guidance (Dindler and Iversen 2009, Prensky 2003), which is the core of museum learning practices.

Similarly the *Tree of Life Table* (Hornecker 2008), a multi-touch interactive surface, was designed to provide visitors with an exploratory access to information about different animal species. The installation was tested at the Museum of Natural History in Berlin with interesting results. Visitors were supposed to touch bubbles, dynamically appearing on the table surface, and

many of them spontaneously explored playful hands movements. Some tapped the surface with one finger or more at the same time, others instead caressed it with a flat hand (Hornecker 2008). According to the author, the emergence of playful interaction enriched visitors' experience, adding a creative and personal aspect to information access.

In other studies (Muise and Wakkary 2010, Hall and Bannon 2005) play was intentionally introduced, in order to make museum visits more engaging. Hall and Bannon (2005) investigated the impact of ubiquitous computing on children's museum experience. They created an interactive environment, in which children could learn about the exhibition, playing with copies of the displayed items, which were augmented with RFID tags. They could also leave their feedback about the exhibition talking to a phone, and listen to other visitors' comments activating a radio (Hall and Bannon 2005).

Finally Muise and Wakkary (2010) proposed *Kurio*, a hybrid system, composed by a series of tangibles, a personal digital assistant device (PDA), and a tabletop display, so to introduce playful problem solving, framed within a narrative framework. Hence the visitors were supposed to play the role of lost time travellers, who had to repair their time compass, collecting information about their temporary present. The authors aimed at enriching' families learning experience in museums, through a constructivist approach.

These studies provided a valuable background for our study; however, they focus on the micro level and do not discuss their solutions in relation to museum practitioners' needs and the macro level.

The macro level is instead discussed by organisational studies, such as Janes (2009), Hooper-Greenhill et al. (2004), and Dysthe et al. (2012).

According to Janes (2009), museum innovation is stuck, as it lacks a vision about what museums have to offer to society. From the perspective of the museum practitioners, the whole process is led by external funding and educational organisations, which are in charge of evaluating the "relevance" of museum practice for society, but do not share museum professional values. The notion of relevance is also central to the introduction of digital technologies, which needs to be evaluated from the perspective of society, in terms of creation and communication of culture, and of museum practitioners, who do not exactly know "what to do with them"[1] (Janes 2009).

The relevance of museum practice is discussed further, in socio-political terms, by Hooper-Greenhill et al. (2004) and Dysthe et al. (2012). Hooper-Greenhill et al. (2004) present a complex quantitative investigation, regarding how the *Renaissance in the Regions Education Programme* affected primary school pupils and their teachers in England. The program had a socio-political agenda, as it aimed at grouping museums into regional Hubs so to develop the educational potential of museums (Hooper-Greenhill et al. 2004). A quantitative survey was conducted, which according to the researchers proved that the initiative was "achieving government targets", in eliciting learning and in cultivating pupils' confidence and cultural identity (Hooper-Greenhill et al. 2004).

Dysthe et al. (2012) propose a similar perspective regarding Danish museums, claiming that several art museums, such as ARKEN and Nikolaj Kunsthallen, were founded in Copenhagen, with the socio-political agenda of cultivating a culturally aware citizenship. These two museums were established in the western area of the city, which has recently become the home of immigrants from the Middle East and Asian countries (Dysthe et al. 2012). Moreover, the innovation process of museum practice is discussed as a shift from the Modernist to the Postmodernist paradigm, which implies a change from an authoritarian to a dialogic approach to learning. In the Postmodernist paradigm, the museum is supposed to engage into a knowledge

[1] This is confirmed by our empirical data, see also Marchetti and Nandhakumar (2011).

exchange with visitors, acknowledging that learning is an individual outcome, based on past experience and cultural background (Dysthe et al. 2012). The notion of dialogue is also presented as a key element, from micro and macro levels, referring to the communication between museum and visitors, and also between museums and society. In conclusions Hooper-Greenhill et al. (2004) and Dysthe et al. (2012) are among the few studies linking micro and macro levels; taking into account their contributions, this paper discusses the relevance of digital technologies, for the activation of a dialogue involving museums, individual visitors and other organisations.

The MicroCulture Project

The MicroCulture study is based on ethnomethodologies (Silverman 2005) and participatory design (Druin 1999), supported by interpretive analysis of video recordings. This approach was chosen, as it allows to analyse interaction details and individual responses, in the context of action (Dourish 2007).

Our contexts of research are: the Viking Museum in Ribe (Dk) and the Transport Museum in Coventry (UK). The Viking Museum in Ribe displays local archaeological artefacts, dated from Prehistory to the Renaissance, so to tell the story of the oldest town in Denmark. The Transport Museum in Coventry exhibits iconic transportation vehicles, most of them manufactured in Coventry, from the Georgian and Victorian Ages up to contemporary times. Moreover, both museums are experimenting new ways to communicate the story and dynamics of their urban community.

Our study started with a field study in the two museums, conducting observations with classes of pupils and semi-structured, situated interviews (Silverman 2005) with the curators and educators. Afterwards a Participatory Design process was conducted in Denmark with 25 children, circa 10 years old, from a local after school institution. Five co-creation workshops (Druin 1999) were held at the children's afterschool, which provided a good design *collaboratorium* (Bødker and Buur 2002), a space where we regularly engaged in cooperative prototyping. Each session of the design process and the final evaluations was filmed, so to support further analysis and documentation. Hence a series of low-fi and hi-fi prototypes were iteratively created and tested with children and museum practitioners (Marchetti and Petersson Brooks 2012).

The Prototype

The outcome of our participatory design process is *MicroCulture*, a mixed-reality tabletop game; the physical setup includes a flat-screen television (placed horizontally to act as an interactive game board), a webcam (suspended above the television) and a series of paper tangibles (see Fig. 3). Our idea was to create an augmented, playful version of a diorama displayed in the museum, showing the original settlement of Ribe (Fig. 2), so to represent, in an interactive form, the connection between urban development and infrastructures placement by landlords, who should be played by children and guides. However, making a "live" diorama was not feasible, hence the first setup we envisioned consisted of wooden or plastic tangibles labelled with markers, a camera-based tracking system, and a projector. A simulated landscape and its population would be projected onto a box full of sand or on the floor, allowing children to play physically, without fear of breaking anything. A sandbox seemed a promising setup since many children in Denmark like to play with them at home, in kindergartens and schools; moreover, the sand could show material changes on the territory, produced by geological phenomena or by humans. The floor setting was inspired by interactive floor games[2], projections on the floor, often showing advertisement in shopping malls, inviting children and grownups to interact with animated objects or characters (Fig. 4).

[2] See: http://www.gesturetek.com/newscenter/media.php?media=45.

Figure 2. Diorama reconstructing the original settlement of Ribe.

Figure 4. Interactive floor game.

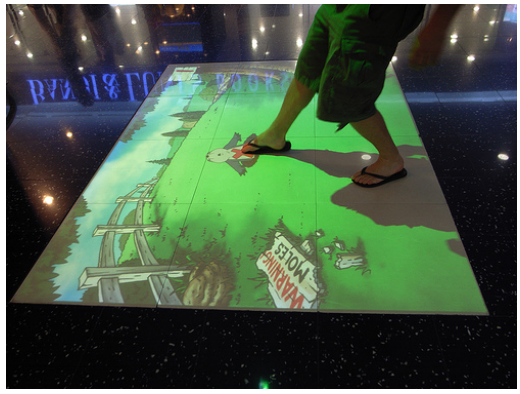

Figure 3. MicroCulture setup.

However, we discarded this solution, as it requires a powerful and expensive projector, as well as a safe, portable, and adjustable way to hang it facing downwards, at the right angle and distance from the floor. Moreover, commercial floor games usually track people via infrared cameras, which works fine when interaction is mediated through a warm human body, but difficult to adapt when cold tangibles are used. Some researchers have proposed other interactive floors, for instance to support individual and social playful interaction in public spaces (Delbrück et al. 2007), or even language learning for hearing-impaired children (Iversen et al. 2007). However, these systems are complex, require special care and space to deploy, and may be very expensive.

Figure 5. MicroCulture, final test in Ribe.

For our actual setup, we took inspiration from games like *Simcity* and *Monopoly*, and retained as much as possible of physical interaction and group play. The simulation shows a village seen from above, in a typical top-down view of classic 2D adventure games. This MicroCulture implementation is intended to be a stationary installation and displayed with the exhibition. The goal of the game is to place tangibles on the surface, so to create infrastructures in the simulation and make the village flourish (Marchetti and Petersson Brooks 2011) (Fig. 5).

Our new learning platform is entirely developed using off-the-shelf technologies and free software, to cope with museum practitioners' fear of high costs. The game itself is implemented in Python using the Pygame game library, and runs on a standard dual-core PC. The software tracking the paper tangibles is ReacTIVision (Keltenbrunner and Bencina 2007), an open-source tangible-interface development system.

Museum Practice, Technology, and Open Issues

Reflecting on the experience in the MicroCulture project, it is possible to argue that the process of museum innovation and adoption of digital technologies are still unsettled (Janes 2009, Marchetti and Nandhakumar 2011), because a long-term vision about how their introduction could contribute to museum practice is missing.

Museum practitioners from Ribe and Coventry had doubtful thoughts about using digital media, fearing that they may drive visitors' "attention to irrelevant matters"[3]. Moreover, the curators have thought of using audio-video installations, but they are "not sure" what value they could add, from a pedagogical perspective. As a result, the main technological feature, in both museums, is represented by TV screens, integrated in walk through installations (Fig. 6-7).

However, new settings are explored in both museums, mainly walk-through reconstructions and playful spaces, like the full-scale reconstructions of the Viking Village (Ribe) and a street scene from World War II (Coventry) (Fig. 8-9). Two thematic exhibitions are currently open in the two museums: *Why Ribe?* and *Ghost Town*. The exhibition space is in both cases interactive but low-tech: in *Why Ribe?* archaeological materials are hidden in cabinets, to be re-discovered by the visitors (Fig. 10). Similarly, in *Ghost Town* walk through spaces are open for visitors to explore (Fig. 11).

Figure 6. Viking Age metal work practice, Ribe.

Figure7. Screen showing an old news report, Coventry.

According to the curators Why Ribe? and Ghost Town were created to open a dialogue with visitors, confirming the interpretation of museum innovation as aiming at a Postmodernist dialogic paradigm (Dysthe et al. 2012). Why Ribe? aimed at communicating the tentative nature of archaeological practice, while with Ghost Town the curator wanted to start a conversation about the economic crisis, that in the 80's forced cars factories to close, causing an identity loss to the community. Interestingly Ghost Town was created by local design students from Coventry University, and more cooperations have been planned.

The creation of such thematic exhibitions embodies a micro and a macro level goal, for the micro level to provide an immersive experience to the visitors, creating an illusion of coevalness. As for the macro level, this practice represents an emergent strategy to pursue innovation, on a smaller scale, without endangering the reputation of the museum; we call this practice innovation enclosure (Marchetti and Nandhakumar 2011). In this study, it is argued that sensible use of digital technologies may enrich both the creation of immersive reconstructions and innovation enclosures.

[3]A frequent statement in our interviews.

Figure 8. Walk through Viking Age settlement, Ribe.

Figure 9. World War II scene, Coventry.

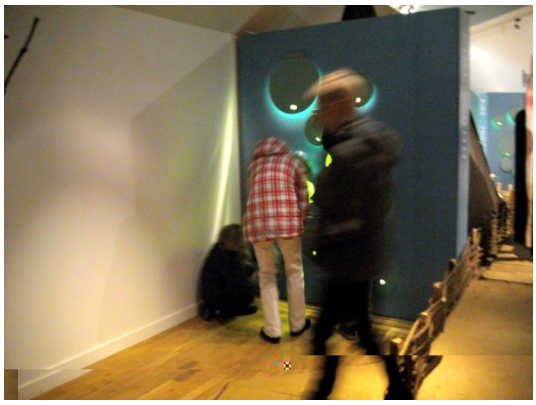

Figure 10. Children opening cabinets, Why Ribe?.

Figure 11. Walk through boarding room, Ghost Town.

Diachronic Perspective and Cultural Capital

MicroCulture can be considered an exploration of what digital technologies have to offer to the process of museum innovation, specifically regarding **learning practice** (micro level) and **innovation practice** (macro level). Therefore, two main issues are addressed:

- How to enrich museum learning practice, so to allow visitors (specifically children) and guides, to communicate in a playful apprenticeship in thinking (Rogoff 1990) and achieve an intuitive understanding of the socio-cultural meanings of historical processes (micro level).
- How to take advantage of technologies, intended as flexible boundary objects (Star and Griesemer 1987), allowing innovation enclosures to become agile and cooperative, with active involvement of external institutions (macro level).

The two perspectives are discussed in the next sections.

Diachronic Perspective and Dialogue: The Micro Level

Current museum learning practice is based on experts' guidance (Dysthe et al. 2012), aimed at supporting young visitors in grasping the meaning embodied in museum artefacts. Additional aid is provided through tangible and walk-through reconstructions (Fig. 8-9). These installations have the double function of showing how fragmented artefacts looked like, at a particular *point* in time, and of eliciting an immersive and engaging experience, creating an illusion of coevalness. In this sense, the creation of tangible installation seems attached to a synchronic perspective on history.

However, history is a social process, determined by individuals' relations with each other, within their society and the social forces, which from individual action may produce unexpected or even undesired results (Carr 2001). This social process involves also sociomaterial relations between individuals through and with their environment (Ingold 2000). Cultural phenomena emerge from these sociomaterial relations; authors such as Akrich (1992), Henare et al. (2007), and Graves-Brown (2002) propose a similar perspective discussing technological progress as an entanglement of knowledge, political agendas, cultural and sociomaterial factors, concretised through actions affecting a community and its environment.

Ribe and Coventry represent two emblematic cases. Ribe flourished in the beginning of the Viking Age as a seasonal market place, in 700 King Godfred partitioned the market into discrete lots, to be rent to the merchants, who developed attachment to the land and started a village (Campbell and Valor 2007, Jensen 1991). Harald Bluetooth in the 10th century re-organized and fortified the village, which became an influential town (Jensen 1991). The development of Coventry is related to the transportation industry[4], which started in the Georgian and Victorian times with bicycles production. In modern times cars manufacturers opened their factories in Coventry, hence political authorities invested money to build and keep streets, connecting factories and residential areas. These interventions contributed to the development of Coventry identity as a modern industrial centre.

Urbanisation of Ribe and Coventry is a hot topic for the two museums; however, they never tried to communicate it through tangible installations, relying upon educators' verbal accounts. According to our interviewees, it is difficult to imagine a better communication mode for historical processes, probably due to the sequential nature, verbal language and historical process share (Bakhtin 1986, Carr 2001). However, our study suggests that verbal accounts might distort historical processes into linear sequences of facts. Moreover, use of verbal language elicits a static communication, so that guided tours converge towards lectures, in which guides act as teachers while children listen. Guides from Ribe and Coventry said that since children do not ask questions, it is difficult to understand what they are gaining from their tour, in terms of learning and engagement.

In our view, digital technologies have great potential to overcome these two issues, as they allow for a natural and compelling representation of dynamic processes, combining audio-visual input with players' actions.

Play is seen as a promising learning framework, as it allows players to conceptually reflect upon their actions and related implications, through manipulation of material objects (Bateson 1972, Vygotsky 1978). Moreover, through play knowledge could be structured into goal-directed activities, like in Muise and Wakkary (2010), allowing visitors and guides to engage into an apprenticeship in thinking, in which visitors can be supported in going beyond their "zone of proximal development": the boundary between what they know and what they can learn (Rogoff 1990, Vygotsky 1978). Finally play can also be seen as a state of mind (Apter 2007), allowing children to become inquisitive and gain meaningful information by asking questions.

Initial results show that a stationary tangible setup, like MicroCulture, are ideal to be displayed in museums and to support synchronous social interaction for a short time (Hornecker and Stifter 2006). Moreover, They also allow for the creation of persistent artefacts, which might be later shared with other visitors (Dindler and Iversen 2009) and become, even temporary, part

[4] Information about Coventry were gained through interviews with the museum curator.

of the museum's exhibition, providing visitors with a sense of pride; in the next section, the relevance of technologies is discussed for the macro level and in relation to their specific affordances.

Innovation Enclosures and Cultural Capital: The Macro Level

Use of standard technologies could contribute significantly to the process of museum innovation from the macro level perspective, supporting strategies, like innovation enclosures, and strengthening museum connections with society, in the creation of cultural capital (Bourdieu 1986).

According to Bourdieu (1986), cultural capital emerges in an *embodied state*: "long-lasting dispositions of the mind and body" (Bourdieu 1986), an *objectified state* as cultural goods, and an institutionalized state, "a particular form of objectification that guarantees the creation of cultural capital itself" (Bourdieu 1986).

In our scenario, museums would become centres for the creation of cultural capital, in which the *embodied state* corresponds to the creation of regular and long-lasting cooperation practices, between museums and other actors, such as IT companies, universities or other research oriented organisations, and schools, who could provide new contents and inspirations. The *objectified state* corresponds to new applications designed for digital installations and concrete benefits for the organizations involved. It could be PR and fiscal advantages for companies, and new pedagogical tools and approaches for schools or research oriented organisations. Moreover, companies and educational institutions could cooperate, starting joint projects and attracting new funds. Finally the *institutional state* corresponds to the creation of close relations among the different institutions, whose specific interests may be bridged through the creation of cultural capital in itself. For instance, simplified versions of the applications displayed in museums could be introduced in schools, bridging schools and museums learning practices. Hence a dialogue between teachers and museum practitioners could emerge, leading towards the creation of new learning approaches and practices in both contexts. For instance, although MicroCulture was intended as a stationary installation for the museum, facilitating synchronous interaction, but it could be developed into a *laptop application* (standalone or web-based) and a *mobile device app* (for smartphones or for wearable devices). Hence the settlement administered by a group of visitors might be downloaded through laptop or mobile applications (online or standalone) and integrated in school or play activities. Moreover, migrating the same application to other platforms, might support forms of multimodality through different devices, and their specific interaction and visualisation styles.

In this scenario, off-the-shelf, standard technologies and open source software are promoted, in line with Hall and Bannon (2005) and their RFID augmented installation. The use of off-the-shelf technologies has several advantages, in relation to the doubts expressed by museum practitioners. Hardware can be bought for reasonable prices and may allow free access to simulators and development kits. It can also be re-used in new configurations, turning innovation enclosures into an agile, exploratory practices, whose costs can be loaded on software development. Moreover, standard technologies can rely upon organisations and large communities of developers, which could offer their expertise, in starting eventual cooperation.

In this sense, adoption of digital technologies implies to embrace tools and knowledge broadly spread within society, so that the practice of innovation enclosures may turn into a *boundary objects*, creating a mediating *trading zone* (Star and Griesemer 1987) for co-creation and negotiation with potential partners and users (Orlikowski 2007). Taking into account all the possibilities, to develop one system across different scenarios, the museum would become the centre of an open community, developing and taking advantage from the shared creation of cultural capital, similar to existing open source communities, in which individual volunteers co-create new applications, for standard software and hardware platforms, such as the UNIX community (Iqbal et al. 2011).

Furthermore, museum innovation could be supported through the creation of a favourable global network, which is defined as a necessary "set of relations between an actor and its neighbours and the neighbours and others" (Law and Callon 1992). Something is already happening, as the exhibition of *Ghost Town* in Coventry was created in cooperation with design students from Coventry University, and The Viking Museum in Ribe has recently invited students from Aalborg University in Esbjerg to create new digital settings.

Conclusions

Museum innovation is still unsettled (Janes 2009, Marchetti and Nandhakumar 2011), especially regarding introduction of digital technologies, which seems to miss a long-term vision. Moreover, museum studies present a fragmented picture, focusing on two parallel perspectives: a situated one dealing with learning practice and visitors' needs (Hornecker 2008), which we call *micro level*; and an institutional one, dealing with the role of museums within the whole society (Janes 2009), which we call *macro level* (Fig. 1).

Taking into account these insights and results gained from the MicroCulture project, this paper presents a unifying perspective on the relevance of digital technologies, within the process of museum innovation, from both levels. Regarding the micro level, digital technologies could be used to provide interactive representations of historical processes, providing visitors with an intuitive understanding of the socio-cultural meanings they embody and allowing them to engage in a playful dialogue with guides. Regarding the macro level, adoption of standard technology may enrich the emergent practice of innovation enclosures (creation of small-scale thematic exhibitions), providing flexible platforms, which could be re-used in different configurations and also bridging museums with other organisations, who may provide new contents and inspirations. In this way, museums will become centres of an open global network engaged in the creation of cultural capital, from which all society will benefit.

Further studies will be conducted in exploring the implications of introducing digital technologies in museums, at both levels, developing new versions of MicroCulture, including a new simulation about the history of Coventry, which may allow for further comparisons between the two sites.

REFERENCES

Akrich, M. "The De-Scription of Technical Objects." *Shaping Technology/Building Society. Studies in sociotechnical change*, ed. Bijker and Law, pp.205-224, MIT Press, 1992.

Apter, M. "Reversal Theory: The Dynamics of Motivation, Emotion and Personality." Oneworld Publications, Oxford, UK, 2007.

Bakhtin, M., Holquist, M., and Emerson, C. "The Problem of Speech Genres." *Speech Genres and Other Late Essays*, University of Texas Press, 1986.

Bateson, G. "Steps to an ecology of mind." Jason Aronson Inc., Northvale, New Jersey, London, USA, 1972.

Bourdieu, P. "The forms of capital." *Handbook of Theory of Research for the Sociology of Education*, ed. J.E. Richardson, pp. 241-258, Greenword Press 1986.

Bødker, S. and Buur, J. "The Design Collaboratorium – A Place for Usability Design." *ACM Transactions on Computer-Human interaction*, pp. 152-169, vol.9, no. 2, June 2002.

Carr, E. H. "What is history?" Palgrave, Houndmills, Basingstoke, Hampshire, 2001.

Delbrück, T. et al. "A tactile luminous floor for an interactive autonomous space." *Robotics and Autonomous Systems*, pp. 433-443, no. 55, Elsevier, 2007.

Dindler, C. and Iversen, O. "Motivation in the museum-mediating between everyday engagement and cultural heritage." *NORDES'09: Engaging Artefacts*, Oslo, Norway, 2009.

Dourish, P. "Where the action is." Cambridge, MIT Press, 2001.

Druin, A. "Cooperative Inquiry: Developing New Technologies for Children with Children." *Proceedings of CHI'99*, pp. 592-599, May 15-20 1999, Pittsburgh, USA, 1999.

Dysthe, O., Bernhardt, N. and Esbjørn, L.. "Dialogbaseret Undervisning. Kunstmuseet som læringsrum." Skoletjeneste, 2012.

Graham-Campbell, J. and Valor, M. "The archeology of Medieval Europe, vol.1, eighth to twelfth century AD." Aarhus University Press, 2007.

Graves-Brown, P. M. "Matter, Materiality and Modern Culture." Routledge, London, UK, 2002.

Hall, T. and Bannon, L. "Cooperative design of children's interaction in museums: a case study in the Hunt Museum." *CoDesign*, vol.1, n.3, pp. 187-218, 2005.

Henare, A., Holbraad, M. and Westel, S. "Thinking through Things, Theorising artefacts ethnographically." Routledge, 2007.

Hooper-Greenhill, E., Dodd, J., Phillips, M., O' Riain, H., Jones, C. and Woodward, J. 2004. "What did you learn at he museum today? The evaluation of the impact of the Renaissance in the Regions Education Programme in the three Phase 1 Hubs (August, September and October 2003)". Research Centre for Museums and Galleries. Museums Library and Archive Council, London, UK.

Hornecker, E. "I don' understand it either, but it is cool!"- Visitor interactions with a Multi-Touch Table in a Museum." *Proceedings IEEE Tabletop 2008*, pp. 121-128, 2008.

Hornecker, E. and Stifter, M. "Learning from Interactive Museum Installations About Interaction Design for Public Settings." *OZCHI 2006*, Sydney, Australia, 2006.

Ingold, T. "The Perception of the environment. Essays on livelihood, dwelling and skill". Routledge, London, UK, 2001.

Iqbal, J., Quadri, S. M. K. and Rasool, T. "Open Source Systems and Engineering: Strengths, Weaknesses and Prospects." Trends in Information Management (TRIM) Vol. 7 No. 2, July – December 2011, University of Kashmir, India, pp. 188-197. Originally published in Proceedings of 1st Workshop on Open Source Systems Engineering, Toronto May 15, 2001.

Iversen, O. S., Kortbeck, K. J. Rosengreen Nielsen, K. and Aagaard, L. "Stepstone - An Interactive Floor Application for Hearing Impaired Children with a Cochlear Implant." *Proceedings of Interaction Design and Children 2007*, pp.117-124, ACM Press, 2007.

Janes, R. "Museums in a Troubled World: Renewal, Irrelevance, or Collapse?" Routledge, London, UK, 2009.

Jensen, S. "Ribes Vikinger." Den Antikvariske Samling, 1991.

Kaltenbrunner, M. and Bencina, R. "reacTIVision: a computer-vision framework for table-based tangible interaction." *Proceedings of TEI 2007 The First International Conference on Tangible and Embedded Interaction*, ACM, 2007.

J. Kidd, I. Ntala, and Lyons, W. "Multi-touch interfaces in museum spaces: reporting preliminary findings on the nature of interaction." *Re-thinking Technology in Museums: Emerging Experiences*, ed. Ciolfi, Scott, and Barbieri, University of Limerick, 2001.

Law, J. Callon, M. "The Life and Death of an Aircraft: A Network Analysis of Technical Change." Shaping Technology/Building Society, pp. 21-52, ed. Bijke, W. E. and Law J., The MIT Press, Cambridge, Massachusetts, London, UK, 1992.

Marchetti, E. and Nandhakumar, J. "On the edge between tradition and innovation: Reassembling museums as emerging creative organizations." *Proceedings of EGOS Colloquium 2011*, Gøteborg, Sweden, July 2011.

Marchetti, E. and Petersson Brooks, E. "Playfulness and Openness. Reflections on the creation of learning technologies", Proceedings of ArtsIT 2011, Second International ICST Conference on Arts and Technology, Springer, 2012.

Muise, K. and Wakkary, R. "Bridging Designers' Intentions to Outcomes with Constructivism", *Proceedings of the 8th ACM Conference Design of Interactive Systems*, Aarhus, Denmark, 2010.

Prensky, M. "Digital Game-Based Learning." *ACM Computers in Entertainment*, vol.1, no. 1, NewYork, October 2003.

Rogoff, B. "Apprenticeship in Thinking. Cognitive Development in Social Context." Oxford University Press, 1990.

Silverman, D. "Doing Qualitative Research." Sage, 2005.

Star, S. L., and Griesemer, J. R. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology 1907-39." *Social Studies of Science*, pp. 387-420, Vol. 19, No. 3. SAGE, London, Newbury Park, and New Delhi, 1989.

Vygotsky, L. S. "Mind in society: The development of higher psychological processes." Cambridge, MA, Harvard University Press, 1978.

ABOUT THE AUTHORS

Emanuela Marchetti: Master in archaeology and IT product design. Marchetti has strong interest in investigating material culture and social interaction in context of learning and everyday practice. As a Ph.D. student at Aalborg University (Denmark), she is conducting a participatory-ethnographic study about museum innovation, material culture and learning.

Dr. Andrea Valente: After my PhD in computer science on formal languages and type systems, I transferred from Torino University Italy, to Aalborg University Esbjerg, Denmark. I work on e-learning and knowledge management. Recently I joined the Department of Architecture, Design and Media at Aalborg Esbjerg.

ISSN (online): 2246-123X
ISBN (online): 978-87-7112-383-8

AALBORG UNIVERSITY PRESS